THE

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(J. A. BERLY'S).

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BARE-WIRE TRANSMISSION TO PRIVATE HOUSES.

A VERY interesting discussion is at present taking place in our American contemporary *Electrocraft*, which is the organ of the National Electrical Inspectors' Association, upon the advisability of adopting all-porcelain in place of the usual brass-protected porcelain sockets for lamp-holders. The problem is to a large extent peculiar to America, for two reasons, the first being that the Edison screw-socket lamp is the one almost entirely adopted, and the second that American practice permits of high-pressure overhead lines entering a building, current being often supplied on the alternating system, and converted to low-pressure supply on the premises by means of a transformer. The conditions thus established are the possibility of a swinging contact being made between high and low-pressure wires, such contact being so slight that fuses have not time to melt, but quite sufficient for anyone who is at the time in touch with an unearthed pole of the secondary supply to receive a violent and very possibly a fatal shock. The extreme likelihood of such an occurrence is rendered apparent when it is remembered that it is by no means the universal practice for American electricity supply companies to earth one pole of their secondary circuits. Indeed, we find in the correspondence considered such a laudatory paragraph as the following:—"I might state that the lighting company of Montreal is doing a great thing for the Montreal citizens; that is, the grounding of all transformer secondaries. Doing this, you no doubt know, to a great extent prevents many accidents or loss of life, should the primary wires get crossed with secondary by some cause or other, throwing the high voltage on the house wires or fittings."

The screw-socket system is peculiarly adapted for the bestowal of shocks upon unwary persons handling lamps or lamp-holders, and this should be remembered by everyone handling electric signs or other apparatus involving lamp devices imported from America. The outer screwed surface of the Edison lamp constitutes part of the conducting circuit. In some makes of this lamp, the brass butt projects beyond the socket from 1 to 2½ threads of the screw, and this is quite enough contact surface to give the fingers of any person handling the lamp a bad shock. One writer, representing the Rocky Mountain Fire Underwriters' Association, states that "personal inquiry and observation have given the writer knowledge of two cases of death from persons coming into circuits of more or less voltage while handling key sockets, and 14 violent injuries from the same cause have appeared in this district within the month. This is known as an exceptionally dry district." His conclusions are that, if the lamp base is properly designed and the line earthed, the cord properly knotted or otherwise protected from steam, and the cord tips soldered in the socket, danger to human life is practically removed.

Other remedies suggested in the correspondence are making the shell of the socket lining longer, using chain pulls with insulating links, using reinforced cord for all pendant lights, and dispensing with porcelain shell sockets over specially inflammable stuff or where exposed to flyings of combustible material. It is interesting to ascertain how the question indirectly affects this country. In the first place, extreme care in the construction of overhead high-pressure transmission lines is evidently necessary. Next, we may be thankful that the bayonet-socket fitting is in extended use in this country, and as little divergence from this type as possible should be made. Thirdly, switches introduced into lamp-holders are not an unmixed blessing. And, fourthly, exposed porcelain insulating material is, as we are well aware, extremely liable to injury owing to rough usage, and when chipped and cracked constitutes a grave source of danger.

Peat Fuel in Michigan.

So much is heard of peat in Ireland, that one is apt to overlook the fact that other lands are supplied with many times the area. An account appears in *Power* of the manufacture of peat fuel in Michigan, where a company owning 136 acres of bog land, averaging 10 ft. in depth, estimates the contents to be 2,000,000 tons of raw material. This, at 10 per cent. of dry stuff, should yield 200,000 tons of fuel. The German wet process is employed, but it is carried out mechanically as far as possible, the material being excavated by dredging, exactly as was recommended—fruitlessly—by Mr. W. H. Booth to the Irish Government five years ago. Such a method abolishes the cost of draining, and this is important. A dipper dredge is used, the dipper working upwards in the bog, and holding $\frac{3}{4}$ cb. yard. The material is dumped into scows, and these are towed to a wharf, where it is removed by an elevator to a second-floor grinding mill, followed by a cutter with 70 blades working in a cylinder fitted with spiral blades. The cut stuff is then kneaded and pushed into a compression chamber, which exudes it in 4 in. × 12 in. strands at the rate of 34 ft. per minute. These are cut into 4 in. × 4 in. sections, cross-cut into blocks and carried forward to a drying chamber.

The finished material is said to contain 16·7 per cent. of moisture, 55·3 of volatile matter, 20·5 of fossil carbon and 7·5 of ash. The calorific value is 10,601 B.TH.U. per lb. It can be burned under boilers in ordinary grates. It is found that a ton of the fuel can be sold for 12s. at a profit.

It is added that in the case of one peat factory, over £50,000 was spent in finding out that an economical fuel could not be made by artificial drying and hydraulic pressure. Another firm sent a representative to Europe, and became enamoured of a "so-called electrical process," and it cost the Americans over £30,000 to learn what they might have learned by reading our comments on the electrical process at the time when this was being boomed. Nearly half a million tons of peat fuel are used annually on the Prussian railways, and the Czar of Russia is said to draw nearly £200,000 annually from rentals of peat bogs.

The New Outlook in Chemistry.

A VERY interesting address was delivered by Prof. T. W. Richards a short time ago in the Royal Friedrich Wilhelm University, of Berlin, upon the importance of purely physical processes in the study of chemistry. The lecture in question was the first of a series dealing with the theory and practice of exact physico-chemical measurement. Prof. Richards began his speech by asking why such a study as sculpture reached its highest point of perfection more than 2,000 years ago, whereas, in spite of the labours of the alchemists, chemistry, as understood at the present day, has only been in existence for some 150 years. In striving to answer this question, the author discussed the various attributes of mind necessary in the equipment of a chemist or man of science generally. The first attribute he considered to be imagination, for lacking it, a man saw only that which he was told to see. The kind of imagination needed by a man of science was not necessarily different from that possessed by the artist. Leonardo da Vinci was equally eminent as a geologist and engineer, and as an artist and poet. Goethe was one of the greatest poets of all time, and made notable contributions to the science of his day. Helmholtz was as great a lover of music as he was a student of its theoretical basis. Charles Darwin, the popular instance to the contrary, probably only lost his sympathy with literary and artistic matters through prolonged bad health. Faraday without imagination would not have made his discoveries, but without common sense he would have ended in a madhouse. Thus common sense, or good judgment, was the second attribute of mind in a man of science. These two attributes, however, were possessed by many of the ancients; yet they made but little progress, for they lacked a third attribute, viz., the power of accurate observation and of making well-planned experiments. Even these three mental characteristics were not sufficient to ensure the development of chemistry, for the leading alchemists who exhibited the necessary type of brain had them, but still lacked the mathematical sense, the power of measurement, of accurately evaluating the numerical relationships of things. Without measurement, chemistry was a purely qualitative observational study, penetrating but superficially into the hidden world. Even in Kant's day the failure of investigators to weigh and to measure caused him to exclude chemistry from the list of true sciences.

Having thus developed his argument that constant measurement was the prime essential for the growth of chemistry as an accurate science, Prof. Richards went on to say that the processes of measurement necessarily adopted were almost purely physical. This was not surprising, for, of our five traditional senses, only taste and smell were chemical in action. The balance, the voltameter, the spectroscope, the methods employed in studying radio-activity, were essentially dependent on physics. Hence, what was needed to assure a continued acceleration in our knowledge of chemistry was more measurement—not indiscriminate measurement, but measurement of those relationships which were termed physico-chemical constants. On studying the work that had already been done in this direction, the observer could not but be struck with the comparative want of precision shown by the constants ascertained. It was possible to weigh a thing with an error not exceeding one part in ten million. The length of the year was probably known to within one part in one hundred million. In chemistry, few results were to be relied upon to within one part in five hundred, and some figures probably exhibited errors of one per cent. Seeing that the error in numerous chemical determinations was one hundred thousand times as great as the error involved in a weighing operation, one could not help wondering whether the supposed constants of physical chemistry might not be variable within small limits. If they varied, the variation must be by law, and the cause was to seek. Doubtless much of our uncertainty regarding many numerical data in physical chemistry was due not to any inherent variableness in the constants, nor to defects in the physico-chemical methods of measuring them, but rather to the superposition of other non-essential phenomena upon the fundamental one it was desired to measure; and an investigator's success depended upon his skill in eliminating from his work the effect of those incidental phenomena. Whether variable or not, the constants needed verification, for it was useless to erect structures of theory upon foundations of doubtful accuracy. If, to give an example, the atomic weights of the metals were not known more accurately than to one per cent. of their true value, the periodic law might be, in its present form, nothing but a vague conclusion.

Prof. Richards devoted the closing passages of his address to a refutation of the supposed objection that it might be a waste of time merely to add another certain decimal place to a collection of dry figures when so many burning practical problems demanded speedy solution outside the laboratory. When attempting to convince the so-called practical man that investigations in the domain of pure

science were advantageous, it was necessary to remember that chemistry was not simply one of the best methods of studying the philosophy of Nature, but was also an indispensable factor in obtaining and preparing most of the material comforts of modern life. Liebig and Sonbeiran little thought of the priceless boon they conferred on suffering humanity when they discovered chloroform; Faraday, studying wires and magnets, never dreamed of the miracles wrought by the modern dynamo; and Röntgen was only seeking to advance scientific knowledge when he discovered the rays that have assisted many a puzzled surgeon in his crucial work.

Electric Power in Mexico.

The country of Mexico with its many industries has of late years been rapidly increasing in commercial importance. An article entitled "The Mexico of To-day," which appeared in the *Times* as recently as September of the present year, was calculated to arouse special interest in commercial circles, inasmuch as it drew attention to the ample opportunities afforded to British exporters, and enterprising manufacturers would be wise to carefully consider the best means of "nursing" this increasing source of prosperity. Manufactures of various kinds are now in active operation, resulting in the repression of disorder and the establishment of the national finances on a firm basis; the production of silk, wine, quinine, and cocoa, has been developed, and railways have been built to convey goods from the interior to the markets of the world.

Mining is one of the chief industries, and the climate being good and labour cheap and abundant, all that is practically necessary for the furtherance of this industry in the country is a cheap supply of fuel and power. The lack of cheap power has, to some extent, hindered the growth of this work in the past, but recent advances indicate that the period of stagnation is rapidly coming to an end.

In Mexico cheap electric power will supply a definite need by effecting a reduction in the operating cost of mining, and so bringing a great tonnage of material within the range of profitable treatment, resulting in the industry flourishing rapidly. It not only provides a safe suitable illumination for the large centres of industry already existing, but it also furnishes the power for ventilating, hoisting, and all operation processes connected with the work of mines.

At Magistral, San Maria del Oro, Durango, a central power plant has been constructed for the Lustre Mining and Smelting Co. consisting of three 400-H.P. and one 200-H.P. gas-producers, two gas engines of 360 H.P. each, and one horizontal gas engine of 190 H.P. The smelting works, when completed, will comprise three electric copper matting furnaces, 36 by 168 in. Only one of the furnaces is as yet in working order, the other two being still in course of erection. The capacity when all the furnaces are in blast will be on an average 450 tons of ore per day. This central power plant besides running these smelting works generates sufficient power to work two 5-stage centrifugal pumps with 500 ft. lifts, three Duplex sinking pumps, six electric drills, ventilators, &c. An abundance of ore yielding gold, silver, and copper, is to be found in these properties.

There is also at hand in Mexico a plentiful supply of all kinds of raw material for the production of iron and steel, with the single exception of coking coal, and there is an increasing inquiry for superior grades of steel. There would therefore be a fine opening there for a perfect electric process of smelting iron.

At Guadalajara an important venture is under consideration for the transmission of electric power from Guadalajara to the Etzatlan and Hostotipaquillo districts of Jalisco, to facilitate the mining and milling industries, and there is every probability that this will be carried into effect.

An estimate for the cost of building a line capable of carrying 5,000 H.P. is in course of preparation for the power company, the Campania de Tranvias Luzy Fuerza de Guadalajara. If this proposition does not succeed, power will probably be taken from the Santiagy River.

The completion of an electric power supply in the Hostotipaquillo district of this State will certainly be the means of materially developing one of the largest milling districts of Mexico. There are now available great ore supplies that can be treated at substantial profits by such electric power, and present development work in the district is placing more ore in sight daily.

It is, therefore, to be seen that the introduction of cheap electric power to the industrial districts of America, which is rich in mineral deposits, where the climate is good and labour abundant and cheap, is going to develop a vast field for the introduction of electrical engineering goods of all classes. Of course, being near at hand, our American cousins are first in the field, but there is no reason why British enterprise should not apply its organisation, which has been more or less successful in other parts of the world, to the exploitation of this new industrial centre.

Circulation of Water in Boiler Tubes.

The U.S. Geological Survey Coal Testing Department, in the course of their duties, made some very interesting tests upon the rapidity of circulation in boiler tubes. For this purpose they employed an apparatus which included a four-bladed propeller rotating on an axis inside the tube to be tested. By means of an electrical connection and a telephone receiver, it was possible to count the revolutions of the fan. The blades of the propeller make an angle of 30° with the axis, and are $1\frac{1}{8}$ in. wide and $3\frac{1}{4}$ in. across outer edges, in a $3\frac{1}{2}$ in. tube. Allowing for a little frictional loss, the motion of the water should be 1 ft. per revolution of the fan. From a diagram of results the effects of cleaning the fires and of firing upon the velocity of the water in the middle tube of the third row up of a Heine boiler are plainly visible. Circulation answers promptly to external conditions, and variations are very wide, a minimum speed of about 50 and a maximum of 140 being recorded, the maximum followed quickly after a fresh charge had been thrown on the fires, while the burning of the fires beyond a certain point produced a rapid drop in circulation—probably because the fires became burned into holes and an excess of air was admitted through the grate.

In another diagram are given plottings which show the number of revolutions for different rates of steaming. These indicate that as the output of the boiler is increased the velocity of circulation is not increased in the same ratio, but lags somewhat behind, the speed for an output of 105 per cent. of the rated capacity falling as much as 15 per cent. below the speed as calculated from the observed speed at 70 per cent. of the rated capacity. It is inferred that the failure to maintain a proportional rotational speed must imply a reduced efficiency at the higher rates. This, of course, must not be allowed too much weight, for when a boiler is being pushed to higher output, the later rows of tubes will usually deal with most of the heat that slips unabsorbed past the hotter earlier rows of tubes.

Placed in the middle tube of the lowest row, a tube mostly encased in firebrick, the revolutions varied from 217 to 291 per minute, with a boiler output that varied from 58·2 to 92·2.

Placed in the third row down, the speed was very slow, which shows how little work such later tubes really perform, and how they merely stand guard against the escape of gas at a high temperature.

The work done by each row of tubes decreases very rapidly as the gases pass upwards, by far the most work being done by the first row of tubes.

These experiments are very interesting as showing something of the rapidity of flow of water in boiler tubes. Very little is known of this. Necessarily the rapidity depends largely on the volume of steam that is made in the tubes. It is possible that when much steam is made it escapes along the top side of the tube to a greater extent than when less heat is passing into the tube, and this may be the explanation of the smaller number of revolutions per minute relatively to output than occur at lower rates of output.

D

ALUMINIUM AS A SUBSTITUTE FOR COPPER FOR ELECTRICAL TRANSMISSION PURPOSES.

By JOHN B. SPARKS.

I.—Introduction.

Although copper has been, and is still, the recognised metal for the cores of electric power cables, the supply and the price of the metal are by no means steady, and there is always the possibility that another metal or alloy may become more suitable; indeed, cables having aluminium as the conducting metal are already on the market. Aluminium as a substitute for copper for overhead lines has many advantages, and several large transmission systems could be named, in which aluminium is the metal used as the conductor. It is the purpose of the following investigation to determine the conditions under which the substitution of aluminium for copper leads to a more economical result.

The most important factors when comparing two metals for electrical purposes are, of course, the relative conductivities.

Aluminium wire has been produced with a conductivity as high as 63 per cent. of that of copper (98 per-cent. Matthiessen standard), but the usual value, and that taken in the following investigation, is 61 per cent.

The specific gravity of copper is 8·9, and that of aluminium 2·7. The coefficients of expansion are 0·000017 and 0·000023 per degree C. respectively. For equal conductivity we have the following relations :—

	Copper.	Aluminium.
Section for equal conductivity ...	1	1·64
Diameter " " ..	1	1·28
Weight " " ...	1	0·5

Let us next consider the tensile properties of the two metals. The following table gives average values of the tensile strengths of the two metals. From these values we see that aluminium has less than half the tensile strength of copper.

Table of Tensile Strengths.*

Property.	Metric units, kg/mm².		English units, lb./sq. in.		Ratio.
	Copper.	Aluminium.	Copper.	Aluminium.	
Elastic limit ...	28	10	39,800	14,200	2·8 : 1
Yield load... ...	36	18	51,000	25,500	2·0 : 1
Ultimate strength	44	20	62,000	28,400	2·2 : 1
Modulus of elasticity	11,300	6,700	16,000,000	9,000,000	1·7 : 1

The lower value of the "modulus of elasticity" in the case of aluminium is an advantage, as the aluminium wire stretches more under stress than a copper wire, thus relieving the stress. When the stress is removed, the wire returns to its original length.

The rule for overhead work in America is to stretch the wires to such a degree that, under the worst conditions (*i.e.*, lowest temperature and maximum wind pressure) the stress in the wire is equal to the stress at the elastic limit.

In the recently issued regulations of the "Verband Deutscher Elektrotechniker," the above permissible maximum stress is taken as one-half of the yield load—*i.e.*, rather less than the elastic limit.

Another rule is to take one-third to one-half the ultimate strength.

Whatever rule is assumed, the maximum stress permissible in the aluminium wire is about one-half that allowed in the copper wire.

The only remaining factor to consider before entering upon a detailed investigation is the relative cost of the two metals.

The prices at the time of writing * are :—

Copper wire ... ... £77 per ton.
Aluminium wire ... ... £177 per ton.

These prices correspond to £64 and £150 per ton respectively for the raw material.

With these prices per ton an aluminium conductor will cost 15 per cent. more than a copper conductor of equal length and conductivity.

The price of £64 per ton for copper is, however, exceedingly low; whereas there is every probability that the price of aluminium will be reduced to a very much lower figure than £150 per ton in the near future.

Indeed, it is expected that the price of aluminium will shortly be reduced to below £100 per ton.†

If the monthly average prices per ton of copper and aluminium are compared, it is seen that although the price of aluminium is, as would be expected, affected by the fluctuations in the price of copper, the fluctuations in the former case are very slight in comparison with those in the latter.

Furthermore, there is every indication that the output of aluminium will be nearly doubled next year, as all the existing aluminium works are being enlarged and many new works are in progress of construction, many of them being practically completed.

The increased output and competition will both tend to lower the price, and it is more than probable that the price per ton may even be reduced below £100 before the end of the year 1908.

II.—Insulated Cables.

Let us investigate first the effect of the larger diameter of the aluminium conductor on the cost of insulated cables.

This 28 per cent. larger diameter means such a large increase in the quantity, and therefore in the cost of insulating material and lead covering, that a large saving will have to be effected in the cost of the cores in order to counteract this, and thus reduce the cost of the aluminium cable to the cost of a copper cable of equal conductivity.

It is evident that as many pounds sterling must be saved in the cost of the cores as are lost in the extra cost of the insulation, &c.

Copper is $\left(\frac{8{\cdot}9}{2{\cdot}7}\right)$ *i.e.*, 3·3 times as heavy as aluminium; the conductivity of aluminium is only 0·61 times that of copper; therefore, for *equal conductivity*, copper weighs 3·3 × 0·61 times—*i.e.*, twice as much as aluminium.

If aluminium wire costs twice as much per ton as copper wire, then cores, of equal length and conductivity, of the two metals will cost exactly the same, and consequently any insulated aluminium cable will cost more than a copper cable of equal conductivity.

At the time of writing, aluminium wire (£177 per ton) costs rather more than twice as much per ton as copper wire (£77 per ton), which makes the case even more unfavourable for aluminium. However, it is quite conceivable that aluminium wire may cost less than twice as much per ton as copper, for instance, £150 and £100 per ton respectively.

Then, as for equal conductivity we require twice as many tons of copper as we do tons of aluminium, the cost of the aluminium cores will be only $\frac{150}{200}$, *i.e.*, three-quarters the cost of the copper cores.

However, the insulation, &c., will cost more in the former case, and in order that this may not counteract the saving in the cores, it is evident that the cost of the cores must be large in comparison with the cost of the insulation, lead covering, &c. It is, therefore, probable that the aluminium cable

* The author is indebted to the British Aluminium Co. for much information concerning the physical and mechanical properties of aluminium.

* See Electrical Review, October 18th 1907, p. 664.

Copper electrolytic H.C. wire (8¼d. per lb.) ... £77 per ton.
Aluminium wire ... ... £177 per ton.

† See Electrical Review, November 1st, 1907, p. 736 (Vol. 61). The price of aluminium ingots now stands at £106 5s. per ton. (See Electrical Review, November 1st, 1907, p. 742.)

The examples worked through in this article have thus little value as a means of comparison (except at the particular prices chosen), but the curves, as will be seen, are *independent of these fluctuations* in the price of the metals, and the examples worked through must be looked upon only as a means of obtaining these curves.

will be the cheaper in the case of low-tension cables of large section, but that, where the cost of the insulation, lead and labour is large in comparison with the cost of the conductor itself, as is the case with high-tension cables, there seems very little chance of the aluminium cable being the cheaper. The disparity in cost will, however, be by no means great, as we shall see when considering high-tension cables, and were copper to become very scarce and dear, aluminium cables would take the place of copper cables, and the electrical industry would suffer little harm.

Let us consider a few specific cases, dealing, in the first place, with low-tension cables.

Low Tension Cables.—For a given section of core and a given voltage, the quantity and, therefore, the cost of the insulation, lead covering and labour, per unit length of cable is independent of the metal used for the core. Consequently we can estimate the total cost of the cable, exclusive of the cost of the material of the core, for various sections of core; in other words, the cost of a "coreless" cable, including, however, the labour costs connected with the stranding of the core.

In fig. 1 a curve is given of the total works cost per km. of single-core, low-tension cable, exclusive of the cost of the core, for various sections of core.

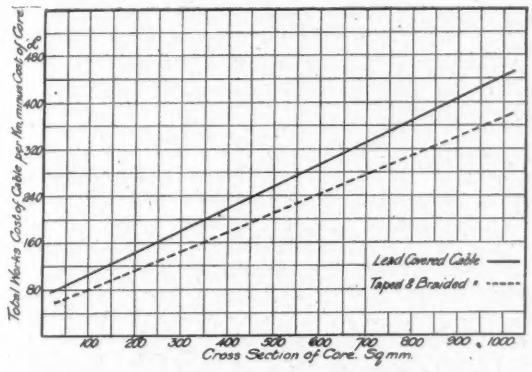


FIG. 1.—COST OF INSULATION, LEAD-COVERING, AND LABOUR FOR SINGLE-CORE L.T. CABLE FOR WORKING PRESSURES UP TO 660 VOLTS.

This curve is for lead-covered cable, such as is used for the feeders of electric railways at working pressures up to 660 volts.

The "broken line" curve is for similar cable, but taped and braided instead of lead covered.

From these curves it is a simple matter to estimate the approximate costs of copper or aluminium cables for any particular market prices of the two metals, and to make comparisons *at these particular prices*.

For example, let us estimate the approximate cost of a single-core, low-tension cable, having a copper section of 400 sq. mm.

This and the following examples must not, however, be looked upon as affording any means of comparison between copper and aluminium cables, except at the particular prices chosen.

They are given here, in order to show how the following curves were deduced, which curves, as explained later, take into account the prices of the two metals.

The examples also show how the approximate cost of copper or aluminium cables can be estimated for any particular prices of the two metals.

Example:— (A) *Copper.*

Section of core	400 sq. mm.
Weight of core per km. (allow 3 per cent. for stranding) = $400 \times 8{\cdot}9 \times 10^{-3} \times 1{\cdot}03$	3·67 tons
Cost of copper wire per ton	£77
Cost per km. of 400 sq. mm. core = 77 × 3·67 ...	£283
From fig. 1, cost of rest of cable per km.	£220
Total cost of cable per km.	£500

An aluminium cable of equal conductivity will have a section of core of $\frac{400}{0{\cdot}61} = 655$ sq. mm.

(B) *Aluminium.*

Section of core	655 sq. mm
Weight of core per km. (allow 3 per cent. for stranding) = $655 \times 2{\cdot}7 \times 10^{-3} \times 1{\cdot}03$	1·82 tons
Cost of aluminium wire per ton...	£177
Cost per km. of 655 sq. mm. core = 177 × 1·82 ...	£322
From fig. 1 cost of rest of cable per km.	£315
Total cost of cable per km.	£640
Whereas the *copper* cable cost...	£500

In order that the copper cable should cost the same as the aluminium cable, copper wire must be at a higher price per ton. Let us find this price—

Cost of copper cable to be	... £640 per km.
But from above, cost of insulation, &c.	... £220 per km.
Therefore cost of cores ...	... £420 per km.

There are 3·67 tons of copper per km. Therefore, price of copper wire per ton in order that the core shall cost £420 per km., is—

$$\frac{420}{3{\cdot}67} = £115 \text{ per ton.}$$

Or we can estimate the price per ton of aluminium wire in order that the aluminium cable may cost as much as the copper cable—*i.e.*, £500 per km.

Cost of aluminium cable to be	£500 per km.
But from above, cost of insulation, &c. ...	315 "
Therefore cost of cores	£185 per km.

There are 1·82 tons of aluminium per km. Therefore price of aluminium wire per ton in order that the core shall cost £185 per km. is—

$$\frac{185}{1{\cdot}82} = £102 \text{ per ton.}$$

Thus for prices of £115 and £177 per ton for copper and aluminium wire respectively, the cables would cost the same. Again, for prices of £77 and £102 per ton the costs of the cables would be the same.

The costs have been estimated for copper sections of 100 and 600 sq. mm., and for the corresponding aluminium sections of 164 and 983 sq. mm. (and for various prices per ton), and the following results have been obtained :—

TABLE I.—COMPARATIVE COSTS OF COPPER AND ALUMINIUM CABLES OF EQUAL CONDUCTIVITY FOR WORKING PRESSURES UP TO 660 VOLTS.

Copper.				Aluminium.			
Section of core.	Price per ton of copper wire.	Total cost of cable per km.	Price per ton of aluminium in order that an aluminium cable may cost the same.	Section of core.	Price per ton of aluminium wire.	Total cost of cable per km.	Price per ton of copper in order that a copper cable may cost the same.
Sq. mm.	£	£	£	Sq. mm.	£	£	£
100	77	176	101	164	177	211	115
400	77	500	102	655	177	640	115
600	77	720	102	983	177	925	115
100	95	192	140	164	140	192	95
400	95	569	139	655	140	570	95·5
100	85	183	117	164	160	203	107
400	85	532	119	655	160	606	105
100	50	151	47	164	50	153	52·5
400	50	404	49	655	50	406	50·5

These results show that whatever section of cable is considered, the price per ton of aluminium corresponding to a given price per ton of copper (*i.e.*, for equal cost of cable) is always the same.

From Table I can be plotted the curve of fig. 2, which gives the price per ton of aluminium corresponding to any

given price per ton of copper in order that a cable should cost the same.

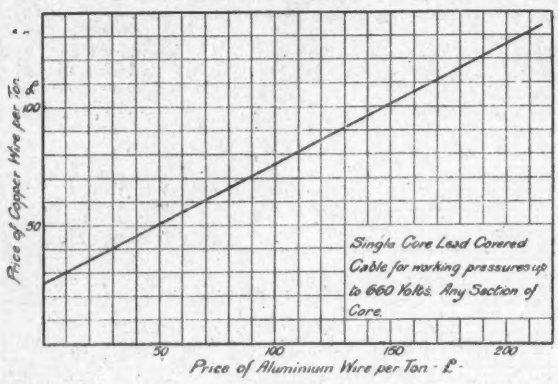

Price of Copper Wire per Ton £
100
50
Single Core Lead Covered Cable for working pressures up to 660 Volts. Any Section of Core.
50
100
150
200
Price of Aluminium Wire per Ton £

Fig. 2.—Curve for Determining which Metal will give the Cheaper Cable for any Market Prices of Copper and Aluminium.

As the above results show, this curve is available for cables of any section, but of course only for low-tension cables up to 660 volts working pressure. *We can see at once from this curve whether it is an advantage to substitute aluminium for copper for low-tension cables, whatever the current prices per ton of the two metals may be.*

Thus, if aluminium wire is at £150 per ton, copper wire will have to be at *over* £100 per ton, in order that anything may be gained by substituting aluminium for copper. The curve produced to cut the ordinate does so at £26, this means that *were aluminium to be obtained for nothing, and copper for £25 or less per ton, it would still be most economical to use copper for low-tension cables.*

(*To be concluded.*)

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Pseudo-Science.

The following gem of electrical theory is contained in a letter to *The Autocar* of November 2nd, on the subject, "Does a car run better at night?" Comment is perhaps superfluous.

Alex. Gardner.

Burnley, *November 7th*, 1907.

[copy.]

Most certainly, some cars do; but all depends on the car. One finds an old car with faulty ignition always runs better at night; this brings one to the conclusion that after a shower of rain, or at sunset, the air is charged with more electricity, the consequence is there is less resistance for the spark between the sparking plug points owing to the mixture being more electrically charged; this gives one a better spark, then follows a better explosion.

It is an acknowledged fact that after a thunderstorm, or on a dewy night, the earth gives off as much as 200 volts more than on a hot summer's day. Probably Mr. S. F. Edge did not notice the above during his tests, owing to the Napier cars being fitted with an almost faultless system of ignition.

Herbert Tomlinson.

The Electrical Trade and Co-operation.

The letter in your issue of November 8th, on the subject of electrical trading and co-operation, must interest all manufacturers, but when the writer suggests British manufacturers can get "on top" by liberally increasing their stocks, I feel a shuddering at such a gruesome idea, as I should think others did in my line of business.

The position in South America, whence your correspondent writes, is that the big American and German companies, backed by their banks, secured concessions, put down stations, and more or less insisted upon their consumers using German and American accessories, motors, &c. Whether such financial methods are correct ones, may be judged by what happened in Germany some three years ago, and what is happening at the present moment in America.

I am one of those people who think our methods over here are the best, refusing to create false markets, but following trade on sound cash lines. I will not speak as to telephones and telephone equipments, but I am in a position to know that the accessories, motors, &c., supplied by the American and German companies for South America, are greatly inferior in design and manufacture to those at present employed in this country, and I am sanguine enough to think that as the native gets educated, he will rebel against using such wares, and insist upon having goods of sound British manufacture in their place.

I am glad to see your correspondent is against the idea that co-operation is the panacea for all these troubles, but really, reading opinions for and against co-operation as a short cut to a paradise of profit, is rather like reading the controversial obituary notices of the late Queen Anne.

Another Manufacturer.

November 8th, 1907.

Emergency Brakes.

As an extreme emergency brake for electric trams, do you think that large steel wire brushes applied to the whole of the available road surface between the rails would be a practicable arrangement? The device could be applied either by hand or by power obtained from a cylinder of compressed air carried for this purpose only.

E. Calvert.

London, N., *November 7th*, 1907.

Prepayment Meters.

The letter from "Call Again" *re* "Prepayment Meters" in last week's Review simply shows the want of encouragement amongst manufacturers generally towards devices brought to their notice. I have at various times tried to introduce really good things, but have invariably failed; one time it would be the office staff, another time it would clash with the one they were already making, and yet again it could not be entertained as it had not emanated from their own particular staffs.

I am a skilled mechanician of 20 years' standing, and know a little of what I am talking about. Some three or four years ago I made a prepayment meter quite on different lines to any of the existing ones. It was cheap and practical in every sense, but after one rebuff I threw it on the scrap-heap, and have since then severely left inventing alone.

I have the idea. Is there one enterprising firm who would take the trouble to look into it?

H. N.

Long-Wheel-Base Trucks.

Mr. Warner, in his letter of the 29th ult., evidently does not wish to understand that I gave a direct denial to his statement "that not only did Mr. McLaren construct radial trucks with differential drive, but he also equipped electric motors on radial trucks."

If Mr. Warner will make inquiries, he will find his statement is not correct.

Geo. Conaty.

Birmingham, *November 11th*, 1907.

Insulating Oils.—A correspondent asks for names of makers.

Hampstead Exhibition.—At this Exhibition, which closed on the 7th inst., there was an exhibit made by Mr. Eric Rivers Smith, of Heath Street, Hampstead, who had effectively arranged cooking and heating appliances of all kinds, including several new and effective designs of radiators. The stand was amply lighted by two Ediswan flame arc lamps.

ECONOMY TEST OF A 7,500-KW. STEAM TURBINE.

THE following data comprise some results obtained during an eight-hour economy test of a turbine installed by the Westinghouse Co. at the Waterside Station of the New York Edison Co. The test was conducted by the latter company, under the direction of Mr. J. P. Sparrow, chief engineer, and in accordance with a mutual agreement entered into before the test between builder and operator. The results given below were obtained by independent computation.

The turbine set tested was of standard Westinghouse construction throughout. It had a maximum rated capacity of 11,250 KW., and was built to work with a steam pressure of 175 lb. at 28 in. vacuum, and 100° superheat. Under these conditions the guaranteed minimum steam consumption was 15·9 lb. per KW.-hour at the generator terminals, for a normal speed of 750 R.P.M. Incidentally, the guaranteed efficiency of the generator was 97·8 per cent., exclusive of friction and windage, at a load corresponding to that sustained during the test. The results of the tests show an economy about 7·5 per cent. better than the guarantee.

The method of conducting the test was as follows:—During the test period, Waterside Station sustained practically all the 25-cycle load on the system, of which the set under test carried 70 per cent., and the other turbine units in the station the remainder. This load was maintained as constant as possible through remote control of the turbine governor by the switchboard operator. From the start to the finish of the test, the maximum variation in load was held within 4 per cent. above and below the mean. Before the test, the turbine unit had been running on a load of 7,000 KW., which was increased to its test load 10 minutes before the start.

The three-phase electrical load was measured by the two-wattmeter method, using two Weston indicating wattmeters of the standard laboratory type, which were calibrated at the New York Electrical Testing Laboratories immediately before and after the test. The power factor was maintained substantially at unity, and all electrical readings were taken at one-minute intervals.

As a surface condenser was used, the water rate was determined by weighing the condensed steam delivered from the condenser hot-well. This condensation was weighed in a tank mounted upon platform scales, with a reservoir above large enough to hold the condensation accumulating between each two weighings (see fig. 1). These weighings, of 12,000 to 13,000 lb. each, were made at intervals of five minutes.

By the loop method of connecting the gland water supply, shown in the sketch, the necessity for correcting condensation by an amount equivalent to the weight of the gland water used is avoided. It will be noted that the continuous gland water circuit is used entirely outside of the weighing apparatus, and that all overflow from the standpipe returns to the hot-well delivery.

As the circulating water was quite salt, any condenser leakage was determined entirely by chemical analysis, employing the silver-nitrate test with a suitable colour indicator. This method proved extremely sensitive, and possessed a decided advantage over the ordinary method of weighing the leakage accumulating during a period when the condenser was not in use and under full vacuum. As samples of circulating water and condensed steam could be taken together, this method made it possible to discover

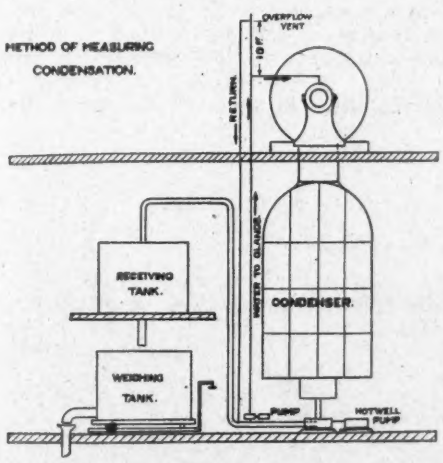


FIG. 1.

any change in the rate of condenser leakage taking place during the test, while the method of weighing, above described, provides only an average result during the period.

In the condensing plant the delivery of the hot-well pump was automatically controlled by a float valve in the interior of the hot well. This maintained the water level therein at a practically constant point, and hence no correction was needed for difference in level of water in the hot well before and after the test.

Steam pressures and temperatures were determined close to the turbine throttle. As usual, the degree of superheat was obtained by subtracting from the actual steam temperature the temperature of saturated steam at the corresponding pressure carried at the time. All gauges and thermometers were calibrated before the test at the United States Testing Bureau. It will be noted that both pressure and superheat were somewhat below the guarantee.

The vacuum was measured directly at the turbine exhaust by means of a mercury column with a barometer alongside for reducing to standard barometer—30 in. This also obviated the necessity of temperature correction between the two mercury columns. During the test, the vacuum was not maintained quite up to the normal.

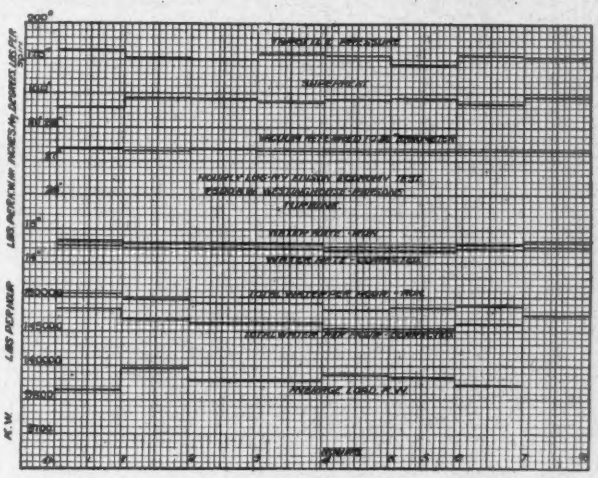


FIG. 2.

The following data represent the results of the tests, calculated for the conditions as actually run, *i.e.*, for internal errors only:—

Duration of test	8 hours
Average steam pressure at throttle, lb. per sq. in. gauge...	177·5
Average superheat at throttle, degrees F. ...	95·74
„ vacuum (referred to 30 in. barometer) inches	27·31
Average load on generator, KW.	9,830·48
„ steam consumption, as tested, lb. per KW.-hour	15·15

Owing to departure during the test from the specified operating conditions upon which guarantees were based, it was necessary to correct the observed results by the following amounts:—

Pressure (2·5 lb. high) correction, 0·25 per cent.; vacuum (0·69 in. low) correction, 1·84 per cent.; superheat (4·26° low) correction, ·29 per cent. These corrections were agreed upon as representative of this type of turbine. When applied to the observed steam consumption already given, the results below, representing contract conditions, were obtained:—

Average corrected water rate during eight-hour test...	14·85 lb. per KW.-hour
Guaranteed water rate	15·9 „ „ „ „

Referring now to the accompanying log (fig. 2), it is interesting, as a check on the average figures above presented, to observe the results segregated into hourly periods, as shown. It will be noted that the load was considerably lower during the first and last hours than during the main part of the test. Neglecting, therefore, these two hours and considering only the six-hour period between, the results are as follows:—

Average corrected water rate, six hours	14·8 lb. per KW.-hour.
Equivalent water rate	10·65 lb. per B.H.P.-hour.
Equivalent water rate	9·8 lb. per I.H.P.-hour.

The last two quantities are determined by applying a conversion factor for the generator efficiency and internal losses.

In connection with these tests, a noteworthy agreement exists between the results observed and those previously obtained from tests of machines similar in design and installed by the Westinghouse Co. in the Manhattan station of the Interborough Rapid Transit Co. New York, and the Long Island City Station of the Pennsylvania Railway. At the same loads, and with equivalent operating conditions, the performances of the machines are almost identical. The economic results, while not exceeding in actual steam consumption the best records of European practice, are, however, extremely good in view of the moderate operating conditions under which the test was conducted. In fact, it is claimed that they represent the best results given by any turbine under similar conditions.

Cable Price Reductions.—MESSRS. BRITISH INSULATED AND HELSBY CABLES, LTD., have made a reduction of 10 per cent. on the list prices of all cables, wires, and flexibles, included in their catalogue of August, 1907.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Prometheus Electric Heating Apparatus.

In the recently issued catalogue of the British Prometheus Co., Ltd., there are placed before the trade an interesting number of artistic designs of their convectors and radiators. No trouble or expense has been spared to make the reproductions as fine as possible. In addition to the ordinary convectors and radiators, the

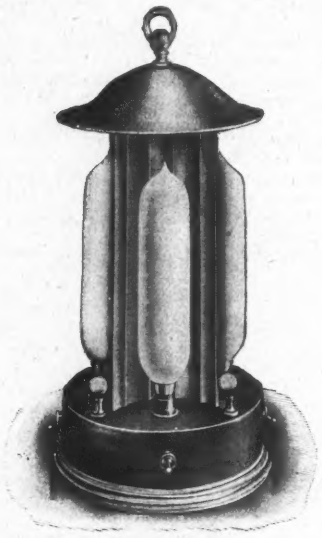


Fig. 1.

Leitner-Prometheus form of glow lamp is described. This is stated to possess many important features, the chief advantage claimed being that, with a filament temperature considerably less than in the ordinary lamp, the power absorption is largely increased, there is an absence of glare, indeed a warm red glow is obtained, and a considerably longer life—all points which will doubtless appeal strongly to electrical supply companies, as well as to actual users. The ordinary size is made to 500 watts, so that a 1,000-watt heater

Fig. 2.

is obtained with two lamps, which is a step towards cutting down the initial cost of radiators. The 500-watt lamps have a clearance between them of at least 1½ in., to avoid raising the temperature of the glass beyond the safe limit. We illustrate a couple of typical heaters taken from among the 50 designs which are included in the catalogue. Fig. 1 shows a polished brass radiator (four lamps) with four switches, and fig. 2 is a typical Prometheus convector.

An Electro-Magnetic Face Plate.

Messrs. Siemens & Halske supply a handy magnetic face plate of the type shown in fig. 3, for use in planing machines, &c., in which cast-iron is largely dealt with. The face has an area of 14 in. × 8 in., and is excited by ·15 ampere off a 110-volt supply, or ·1 ampere at 220 volts direct current. It consists of a divided

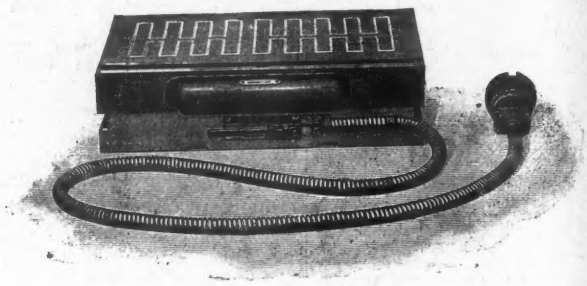


Fig. 3.

cast-iron box containing the elliptical magnetising coil, and a small switch is attached to the side as shown. The arrangement can also be used for steel articles, but in this case the residual magnetism left in the work is difficult to remove entirely, and may be objectionable in some cases. We are indebted to the *E.T.Z.* for these particulars.

The Electric Lighting of Cannon Street.

The introduction of "flame" arcs, especially yellow flame arcs, and the carbons necessary to produce them, has added tremendously to the possibility of lighting large spaces cheaply, and at a cost which cannot be approached by gas.

The yellow flame arc is two to three times as efficient as the ordinary open white arc, and considerably more so than enclosed lamps of any description. The difficulties which offset this are the expense of the carbons and the short burning hours usually obtainable. Cheap flame carbons can be obtained, but they require somewhat special lamps to burn them, and further, the diameter of the carbons used has to be kept particularly small, so that to obtain reasonable hours of burning, some form of magazine lamp is essential.

The Gilbert patent lamp used in the above connection would be more properly termed a multi-carbon lamp, and is put forward by the Gilbert Arc Lamp Co., Ltd., of Chingford, as a practical solution of a magazine lamp, without the unavoidable complication of a magazine lamp proper.

A magazine lamp proper naturally suggests separate loose carbons feeding automatically one after the other into burning position, and this, independently of the moving and loose carbons, involves

Fig. 4. Fig. 5.

The Gilbert Magazine Lamp (Cannon Street Lighting).

certain further requirements in the working of an arc lamp than are customary in this already sufficiently complicated apparatus.

The Gilbert lamp gets over all the above-mentioned details at one stroke, by simply using a number of small diameter carbons in one, or rather each, holder or slider, the works of the lamp remaining as simple, and, in fact, the same as, the works of an ordinary open-type arc lamp.

Instead of mechanism to change carbons, the carbons remain in place, and the change is merely electrical, the arc changing from one pair of carbons to another, and so on, every 15 minutes or so—a much simpler alternative.

The first question is, naturally, whether the change is necessarily objectionable. An observation of the lamps in Cannon Street will

convince observers that this is not so; as a matter of fact, in a reasonably long circuit the fluctuation therein is confined to a momentary variation of about half an ampere, and the actual change only means a diminution of light for a second or two. Of course, the works of the lamp are so arranged as to effect this change as quickly as possible, and also so that the correct electrical conditions are under all circumstances immediately recovered and permanently maintained.

The lamps at Cannon Street are 10-ampere, and burn satisfactorily 10 on 400 or 12 on 460 volts; they are therefore 400-watt lamps, including the steadying resistance. The hours of burning vary from 42 to 45 with slightly different compositions of carbons, and to avoid waste of carbons the lamps can be trimmed to burn to within a few hours of the time required of them. The lamps are usually constructed to take 6 pairs of 16-in. carbons. The cost of this cheap carbon works out to about one-third the cost of flame carbons generally used.

In figs 4 and 5 we show an external view of the lamp and one of the mechanism. The makers have arranged this type of lamp to burn with as low a consumption of power as 210 watts.

In our note of last week on the City experimental lighting we erred slightly. We should have made it clear that for the Cannon Street arc lighting the Charing Cross, City and West End Co. alone are entirely responsible.

LARGE GAS-ENGINE ELECTRIC POWER PLANT.*

The California Gas and Electric Corporation—now a subsidiary of the Pacific Gas and Electric Co.—has been doing some remarkable pioneer work in the suburbs of San Francisco in the installation and operation of very large electric generating units with direct-connected gas engines to supply current for operating electric cars. Over a year ago the Snow Steam Pump Works, of Buffalo, erected at the San Mateo power station near San Francisco three horizontal, duplex, double-cylinder gas engine generator sets. The engine capacity was rated at 5,400 H.P., and the generator capacity at 4,000 kilovolt-amperes for each unit. Each engine has the revolving field of a Crocker-Wheeler three-phase 25-cycle 13,200-volt generator on its main shaft next to its fly-wheel. At the time the engines were constructed they were the largest gas engines in the world, and the generators were, of course, the largest to be driven by gas engines.

Before this plant was started there was some uncertainty in the minds of some electrical engineers on the successful operation of three such large gas engine units when two or more of the big generators were connected in parallel. The test proved that the engines regulated satisfactorily under these conditions.

The plant was intended as a relay station to be held in reserve in case of interruption of the current transmitted 140 miles from Blue Lakes to San Francisco, for the operation of the electric cars of the United Railroads of San Francisco under a 20-year contract, commencing with June 1st, 1906. The engines were built about two years ago.

The unusual conditions prevailing for some time after the disaster of 1906 had something to do with the delay in the placing of the new gas engines in commission, although the large gas generating plant with its gas-holders was completed and undamaged. On account of shortages in the supply of current available for use in San Francisco, it was found necessary to operate the three gas engines regularly during the peak load and at other times early in the year 1907, and they have been in almost continuous operation for a number of months.

The engines are of the twin-tandem double-acting four-cylinder side-crank type, operating on the four-cycle principle. The 5,400-B.H.P. rating of the engine is only on an overload of 35 per cent. The usual overload rating is 15 per cent. for brief periods. The engine delivers 4,600 H.P. at this rating, but normally it will deliver 4,000 B.H.P.

The cylinders are made in two parts, with a circumferential joint in the centre, which is covered by the removal part of the water jacket. The water jackets are cast solid with the ends of the cylinders. The explosion chamber is cast to one side of the cylinder, this making very strong construction.

The pistons are made of cast-iron and bolted together on a circumferential joint. Six concentric cast-iron piston rings without keepers are used. Both the piston rods are 15 in. in diameter and made of two parts—the sleeves, made of nickel steel, and the bolt which extends through the whole length of piston and sleeves. The piston rods are hollow and conduct water to the pistons for cooling purposes.

The cylinders are supported on the bedplate in such a way that they can slide in grooved guides in the longitudinal direction only, to allow for expansion or contraction caused by changes in temperature. The weight of the crank-shaft is 99,734 lb. Its diameter at the rotor fit is 37 in., with a journal bearing 30 in. in diameter by 4 ft. 8 in. long. The crank-pin bearing is 19 by 19 in. The wrist-pin is 17 in. in diameter and 18 in. in length.

The design follows steam engine practice by using two overhung crank-pins, thus avoiding the trouble of keeping more than two main journals on one engine in line. The crank arms are provided with heavy counterweights to partly counterbalance the momentum of the heavy reciprocating parts.

The 23-ft. fly-wheel weighs 97,000 lb.—a rather small weight for such a large engine—but the weight of the rotor has been considered. Although this weight is less than some electrical formulæ would give, it has been found that lighter wheels, when their weight was chosen correctly, have given better results. When the wheel has not the proper weight, parallel operation becomes difficult.

The weight of the main engine frame is 170,000 lb. It contains the bored guides for the main cross-head and the main bearing.

For ignition, the electric make-and-break spark is used in connection with a storage battery, discharging at about 10 volts and one ampere. Each igniter is supplied with a spark-coil indicator. This indicator will indicate constantly the condition of each circuit. When the indicator swings with the igniter, the igniter is in order; when it stays drawn up against the core, the igniter is short-circuited.

The engines are started by compressed air.

The valves, all of which are located on the same side of the cylinder, have a positive motion, imparted through cams, vertical rods and rocker arms from a common lay-shaft geared to the main shaft. The valves are water-cooled.

The speed of the engine is regulated by the governor working on the compression and also on the mixture. A Lombard governor regulates indirectly, with the aid of pistons, moved by oil under pressure. This governor is very powerful, yet very sensitive, and can be easily adjusted to give a slow regulation, which is suitable for parallel operation.

Oiling systems facilitate the lubrication of crank-bearing, crank and cross-head.

The total weight of each twin engine is 600 tons, of which 186 tons represents the weight of the two main-frame castings. The frame carries the main-bearing block and the slides for the large main crosshead. The floor space occupied by each engine is 35 × 74 ft. which is not very large, considering that there are four double-acting cylinders of 42 in. diameter and 60 in. stroke.

These engines have been started and got up to speed in the short time of from 55 seconds to 2 minutes. This means the time required to bring the engine fully up to service from a standing condition, carrying any quantity of load, and synchronised with other engines and hydro-electric plants. This also includes the time required to turn on air, gas, electric current for the igniter, and synchronising at 88 R.P.M.

The three engines have been running about eight months, driving three 25-cycle three-phase generators. The fourth unit, which is under construction, will be installed in the same station, to generate 60-cycle three-phase current, which is the standard on the California Gas and Electric Corporation's transmission lines. It is of practically the same design as the other machines, but the fly-wheel weighs 19 tons more, and the speed will be two revolutions greater, or 90 R.P.M. It is the intention to increase the installation, in time, to six units, aggregating over 24,000 KW. in capacity. It has also been planned to install one 4,000-KW. 60-cycle gas engine generating unit in the company's Oakland power station.

Turning to the generator, the stator frame, which is approximately 26 ft. in diameter, is of cast-iron, provided with ventilating openings to allow a free circulation of air around the ends of the windings and through the ventilating spaces in the core.

The rotor, which is designed for great strength and simplicity, is of cast-steel, made in two sections and bolted together. The pole and pole-shoe are cast in one piece and bolted to the rim. There are 34 poles.

Although the Crocker-Wheeler Co. had built no alternating-current generators prior to 1904, the engineering corps secured the benefit of the data and experience of Brown, Boveri & Co., who had made an enviable record in three-phase work in Europe. The California Gas and Electric Corporation accepted and paid for the three Crocker-Wheeler machines in full several months ago, showing complete satisfaction with their performance.

The gas plant, which was built especially to supply these gas engines, produces gas of a quality high enough for illuminating purposes. The surplus gas is turned into mains connected with the city lighting system of San Francisco and used whenever needed. There are two standard gas generating units, each having a capacity of 400,000 cb. ft. per day, constructed in accordance with the Lowe crude oil water-gas system. The gas-holders, which are located within a few hundred feet of the power station, include one with a capacity of 1,000,000 cb. ft., and two holding 200,000 cb. ft. each. Mains of ample size furnish connection with the gas engines.

This gas contains from 45 to 55 per cent. of free hydrogen. Its heat value averages about 630 B.TH.U. per cb. ft. In the Lowe crude-oil water-gas process the crude oil is heated to a temperature of 300°, being vaporised, and is then mixed with superheated steam. The excess of water is taken out and the vapour and steam pass into a hot chamber, being superheated to 600° F. This high temperature turns the mixture into a fixed oil-and-water gas, which is then purified and passed on to the engines.

When the engines were originally designed, the initial pressure of the gas in the main cylinder was estimated at about 150 lb. per sq. in.

* *Western Electrician.* Abstract.

Wadebridge Electric Lighting.—Messrs. Roche and Penney, of Bristol, have submitted an electric light scheme to the U.D.C., and the question is being considered by a committee.

PROCEEDINGS OF INSTITUTIONS.

The Dielectric Strength of Insulating Materials and the Grading of Cables.

By Alexander Russell, M.A., Member.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, November 14th*, 1907.)

In power transmission, whether by direct or alternating current, the saving of copper effected by using very high pressures has directed the attention of manufacturers to the construction of cables which will withstand pressures of 100 kilovolts and upwards. To design cables which will successfully withstand these pressures, a knowledge of the electric stresses to which the various insulating materials round the core will be subjected under working conditions is essential, as well as an accurate knowledge of the dielectric coefficients, dielectric strengths and resistivities of the insulating wrappings. The author discusses, first, the laws of disruptive discharge, next, the methods of measuring the dielectric strengths of gases, liquids and solids, and finally, the electric stresses on the insulating materials of a single-core cable, with special reference to the grading of cables.

The dielectric strength of an isotropic insulating material in a given physical condition is the maximum value of the electric stress which it can withstand without breaking down.

It is not safe to conclude that a disruptive discharge ensues the moment the maximum electric stress at any point of the dielectric between the two electrodes attains the breaking-down value for that dielectric. The breaking down of a portion of the dielectric may relieve the electric stress on the remainder. A disruptive discharge ensues only when the breaking down of part of the material leads to the electric stress on the remaining part being greater than it can withstand.

The easiest way of finding the dielectric strength of insulating materials is by finding the disruptive voltage between two equal spherical electrodes embedded in the material.

From many experimental results obtained with both alternating and direct pressures, the author concludes that the dielectric strength of air under normal conditions is about 3·8 kilovolts per millimetre.

The practical constancy of the dielectric strength of air under ordinary atmospheric conditions is recognised in the Standardisation Rules (1907) of the A.I.E.E.

In appendix D of the American rules, a table of the sparking distances in air between "opposed sharp needle-points" for sine-shaped voltage waves is given. It is stated, for example, that when they are 7·5 cm. apart the disruptive pressure is 45 kilovolts. It is interesting to notice that if we have two spherical electrodes, each 2 cm. in diameter, and if the distance between their centres be 7·5 cm., so that the minimum distance between the spheres is 5·5 cm., the disruptive voltage is 44 kilovolts, which is practically the same as that between two needle-points 7·5 cm. apart. As brush discharges from the needle-points occur at pressures much less than the disruptive voltage, it will be seen that the ionised air round the points at the instant of the disruptive discharge is probably roughly spherical in shape and 1 cm. in radius.

In determining dielectric strengths it is necessary to have the electrodes at appreciable distances apart, and therefore high voltages must be used. It is not safe to calculate dielectric strengths from the observed disruptive voltages when the electrodes are less than a millimetre apart. When a maximum inaccuracy of more than 1 per cent. is not permissible, they should be at least half a centimetre apart.

In the case of impulsive rushes of electricity, or with alternating pressures at exceedingly high frequencies, the disruptive voltages seem to be independent of the shape of the electrodes.

The dielectric strength of a gas may be deduced from experiments on the sparking voltages between sperical electrodes.

J. N. Collie and W. Ramsay give interesting comparative values of the sparking potentials for various gases contained in glass tubes. The electrodes were of platinum with slightly rounded ends. The following table shows that the dielectric strengths of the gases differ considerably:—

Gas.	Sparking distances in mm.
Oxygen	23
Air	33
Hydrogen	39
Argon	45·5
Helium...	greater than 250

The dielectric strength of helium, therefore, is extraordinarily high compared with that of other gases.

To test the dielectric strength of a liquid, the latter is generally placed in a vertical glass cylinder about 2 in. in diameter. Spherical electrodes about half an inch in diameter are immersed in the liquid, and the distance between them is varied by means of a micrometer screw. The formulæ for deducing the dielectric strength from the disruptive voltage are the same as for a gas.

The electrodes should not be less than 0·3 of a centimetre apart, and at this distance 40 or 50 kilovolts will be required to break down good insulating oils. In some cases when moisture is present much smaller voltages suffice.

In order to find the true dielectric strength of an oil, it is necessary to dry it thoroughly before the test. This can be done by letting hot air bubble up through it. It is inadvisable, however, to heat the oil above 100° C., as considerable discoloration often results, and its physical state alters. When oils are dried in this way perfectly consistent results can be obtained.

In the case of isotropic solids, if the spherical electrodes can be entirely embedded in the insulating material we can proceed as for liquids and gases, the same formulæ being employed.

The method frequently adopted of putting thin sheets of the insulating material between metal electrodes in air is of doubtful value. As the voltage is increased, the air surrounding the electrodes is broken down long before the disruptive voltage is reached. The insulating material heats excessively, and the maximum electric stress to which it is subjected cannot be calculated, as the temperature is rarely uniform throughout, and the resistivity of the medium and the dielectric coefficient vary with the temperature. Results obtained by neglecting the variations of the electric stress due to temperature are useful only when all the conditions of the experiment are mentioned.

When the insulating material is æolotropic the calculation of the electric stresses is very difficult. They vary with the dielectric coefficients and the resistivities of the various constituents, and these quantities vary rapidly with the temperature. Accurate measurements of the mean dielectric strength are, therefore, in many cases almost impossible.

It is the opinion of many of the engineers connected with manufacturing companies that the testing pressures sometimes specified by consulting engineers are too high, and that the times for which they are to be applied are too long. Most insulating materials are composed of organic matters, and are, therefore, not quite isotropic, and so the effect of applying an excessive pressure to a cable or a piece of electrical apparatus for a considerable time is often to carbonise part of the dielectric. This permanently weakens it mechanically, and may shorten its life considerably.

Mr. J. F. Watson, of Callender's Cable Co., has informed me that he has often noticed when repairing extra-high-pressure cables that a partial destruction of the wall of insulation has occurred at places quite remote from the fault. This has probably been caused in some instances by "extravagant testing pressures applied for excessive periods." E. Jona has also noticed similar phenomena. C. E. Skinner states that "long-continued tests are liable to produce incipient burning at points within the insulation," and so he considers them very inadvisable for dynamos, &c.

Stresses in a Concentric Cable having an Isotropic Dielectric.—Let the outer radius of the inner conductor be a and the inner radius of the outer conductor be b. Then the electric stress R at a point in the dielectric distant x from the axis is given by

$$R = V/\{x \log_\epsilon (b/a)\},$$

where V is the P.D. between the inner and outer conductors. The value of R is independent of the absolute potentials of the two conductors, and it obviously has its maximum $R_{max.}$ when $x = a$. Hence—

$$R_{max.} = V/\{a \log_\epsilon (b/a)\}.$$

If a be less than b/ϵ where ϵ is the base of Neperian logarithms, $R_{max.}$ will diminish as a increases. In this case we see that the breaking down of the dielectric round the inner core actually diminishes the maximum stress to which the dielectric is subjected. It is only when the radius of the charred dielectric gets greater than b/ϵ that a disruptive discharge ensues.

Jona, in his paper to the St. Louis Congress, describes an experiment on the disruptive voltages of two single-core cables of very different diameters, but each wound with the same thickness (1·4 cm.) of paper insulation. The core of one consisted of a thin wire 0·1 cm. in diameter, while the other was a copper cylinder 2·9 cm. in diameter. The former broke down at 40 kilovolts, and the latter at from 75 to 80 kilovolts. The former also got exceedingly hot after being subjected to 30 kilovolts for an hour, whilst the latter was still cold after 50 kilovolts had been applied for the same time. If we calculate the maximum electric stress on the dielectric surrounding the thin wire, on the assumption that no part of it is broken down before the disruptive discharge ensues, we get $R_{max.} = 238$ kilovolts per centimetre. Similarly, the experimental results with the thick cable make $R_{max.}$ lie between 76·5 and 81·6 kilovolts per centimetre. This experiment is quoted by Jona to show that the ordinary formula cannot be applied when b/a is large.

If, however, we assume that the disruptive discharge does not occur until the outer radius of the charred dielectric becomes equal to b/ϵ, the experiment on the thin wire gives us—

$$R_{max.} = 40 \times 2{\cdot}718/1{\cdot}45 = 75 \text{ kilovolts per centimetre, nearly,}$$

which, being in substantial agreement with the results given by the test on the thick cable, is a striking confirmation of the theory outlined above.

Suitable Dimensions for a Concentric Main.—Let us suppose that the maximum working voltage V, the density of the current in the inner conductor, and the maximum permissible stress to which the dielectric may be subjected, are fixed. Let us first suppose that the inner cylindrical conductor is solid and that its radius is a. If, then, V/d be the maximum permissible stress, we have—

$$V/\{a \log_\epsilon (b/a)\} = V/d, \text{ and thus } b = a\,\epsilon^{d/a}.$$

If a be greater than d, db/da is positive, and therefore b increases as a increases, but if a be less than d, b diminishes as a increases. In the latter case it would obviously be advantageous to make the inner conductor hollow, its section remaining constant, so as to increase the value of a and diminish the value of b. The quantity of armouring and insulating material used would be diminished by this procedure. We conclude, therefore, that if a solid inner conductor of the required cross-section would have a radius less than d, the inner conductor should be made hollow and its outer radius should not be less than d. In some cases it would be advantageous to make the inner conductor of aluminium.

Although the inner radius of the outer conductor begins to increase when a gets greater than d, the quantity of the dielectric required diminishes until a gets greater than $1{\cdot}25\,d$. But as the saving of insulating material effected by increasing a from d to $1{\cdot}25\,d$ is only about 3 per cent., it is of little importance compared with the increased cost of the armouring.

We conclude, therefore, that high-pressure concentric cables, having isotropic dielectrics, for use at a maximum voltage v should be constructed so that $b = a\,e^{a/a}$, where v/d is the maximum permissible working stress to which the dielectric may be subjected, and a should never be made less than d.

Effect of the Temperature Gradient.—When a concentric main is carrying a current, the temperature of the dielectric is not uniform, owing to the heat generated in the inner conductor. If the dielectric is isotropic, the temperature at any point after the flow of heat has become steady can be readily written down, if we assume that the thermal conductivity of the dielectric remains approximately constant over the range of working temperatures.

The difference of temperature between the inner and outer conductors is probably not greater than 10° C. in the most unfavourable circumstances.

It is known that the dielectric coefficient and the electric resistivity of an insulating material vary rapidly with the temperature. Jona mentions a case where a rise of temperature of 20° C. made the insulation resistance of a paper-insulated cable fall to one-thirtieth of its original value, and even more striking instances could be given. The question of the variation of the dielectric coefficients of dry paper and of solid cellulose has been investigated very thoroughly by Mr. A. Campbell.

The dielectric coefficient diminishes as the temperature diminishes, it therefore diminishes as the radius increases. We see, therefore, that the effect of the dielectric coefficient varying with the temperature is to make the electric stress on the dielectric more uniform.

The resistivity in ohms of the dielectric increases as the temperature diminishes, and therefore as the radius increases. The variation of resistivity, therefore, due to a slight temperature gradient in the dielectric tends again to make the stress more uniform. But if there be a drop of 10° C. between the inner and outer conductors, the electric stresses on the outer layers of the dielectric when the cable is loaded may be much greater than on the inner layers.

The effect of the temperature gradient is to turn the isotropic dielectric into a composite dielectric, and hence it may show the phenomenon of residual charge.

Concentric Main with Composite Dielectric.—To simplify the formula, let us suppose that the dielectric consists of two layers of different isotropic insulating materials at the same temperature throughout. Let ρ_2, λ_2 be the resistivity in ohms and the dielectric coefficient of the inner layer next the inner conductor, and let ρ_1, λ_1 be the corresponding quantities for the outer layer. Let r be the radius of the cylindrical boundary between the two wrappings. Let v', v and v'' denote the instantaneous values of the potential of the outer conductor, the boundary between the two media and the inner conductor respectively, and v_1, v_2 denote the effective values of $v' - v$ and of $v - v''$; let f be the frequency, and $\omega = 2\pi f$, and let v be the effective value of the applied P.D. In general, $\lambda_1 \rho_1$ is not equal to $\lambda_2 \rho_2$, and $v_1 + v_2$ must be greater than v.

It can be shown that v_1 increases with ω when $\lambda_2 \rho_2$ is greater than $\lambda_1 \rho_1$. In this case the electric stresses in the medium next the outer conductor increase as the frequency increases, and the stresses in the inner medium diminish. If $\lambda_2 \rho_2$ were less than $\lambda_1 \rho_1$, the converse effects would take place.

When $\lambda_2 \rho_2$ is greater than $\lambda_1 \rho_1$, v_1/v has its minimum value when ω is zero, that is, with steady pressures, and its maximum value when ω is infinite, that is, with an alternating voltage of very high frequency.

Numerical Example.—Let us assume that the radius of the inner conductor is 1 cm. ($a = 1$), the radius of the boundary 1·5 cm. ($r = 1{\cdot}5$), and the inner radius of the outer conductor 2·25 cm. ($b = 2{\cdot}25$). Let us also assume that for the outer jute wrapping, $\rho_1 = 10^{12}$, $\lambda_1 = 2$, and that for the vulcanised rubber inner wrapping, $\rho_2 = 10^{16}$, $\lambda_2 = 4$. If the direct voltage applied to the conductors be 30,000, then, putting $\omega = 0$, we find that—

$$v_1 = 0 \text{ and } v_2 = 30{,}000, \text{ very approximately.}$$

Thus practically all the electric stress comes on the rubber.

Let us now suppose that an alternating pressure of very high frequency is applied between the conductors. In this case, putting ω equal to infinity, we get $v_1/v = 2/3$, and thus v_1 is 20,000 volts and v_2 is 10,000. Hence, as the frequency increases from 0 to infinity, v_1 increases from 0 to 20,000 and v diminishes from 30,000 to 10,000 volts.

In practice in the case considered the maximum pressure across the outer layer with alternating pressures may be very much larger than when a direct pressure is applied between the conductors, the value of which equals the maximum value of the alternating pressure between the conductors. On the other hand, the electric stresses on the inner dielectric may be much less with the alternating pressures.

The preceding example illustrates that the electric stresses to which the insulating materials may be subjected with direct and alternating pressures are sometimes quite different. Whether the cables break down sooner with direct or alternating pressures depends on the relative values of the dielectric strengths of the materials which are subjected to the greatest stresses in the two cases. Unless we know the physical constants and the dimensions of the various wrappings, it is impossible to say whether the cable will break down more readily with direct or with alternating pressures of the same maximum value.

In the general case, if—

$$\rho_1 \lambda_1 = \rho_2 \lambda_2 = \rho_3 \lambda_3 = \ldots,$$

the stresses with direct pressure will be the same as with alternating of the same maximum value. Even, however, if this relation between the coefficients were approximately true at the start, it would soon cease to be true owing to the heating of the dielectric. Hence the electric stresses will, in the majority of cases, be different with direct and alternating pressures.

At the moment of switching on the direct pressure, the distribution of the electric stresses depends on the dielectric coefficients of the wrappings, but after a few seconds the distribution depends on the resistivities.

With alternating pressures, as the author has previously pointed out, the mere fact that the pressures across the various layers are out of phase with one another may unduly increase the pressure across a particular layer. It is to be noticed also that at the moment of switching-on, if the cable is charged, an excessive stress may be thrown on the dielectric. For this reason, especially when testing cables, care should be taken to discharge them before closing the switch.

The Grading of Cables.—As early as 1898 Jona had constructed single-core cables, the insulation wrappings of which were arranged so that those nearer the core had greater dielectric coefficients than those more remote. The layers next the core were generally of rubber, and round them were wound layers of paper or jute having smaller dielectric coefficients. The more costly rubber insulation was thus concentrated where its high dielectric coefficient partially relieved the excessive electric stress, and its great dielectric strength enabled it to withstand easily this diminished stress. The value generally accepted for the dielectric strength of pure vulcanised para is 15 to 20 effective alternating kilovolts per millimetre or 20 to 30 direct kilovolts per millimetre.

According to Jona, the value of the dielectric coefficient λ of pure vulcanised rubber is 3. We can increase the value of λ without appreciably weakening the dielectric strength by "loading" it with certain materials.

I am indebted to Mr. Jona for a sample of one of his graded cables. This cable was tested with a pressure of 150 kilovolts at the Milan Exhibition without being appreciably affected by the test.

The conductor consists of 19 strands of copper wire, the diameter of each of which is 3·3 mm. The cross-section of the copper is, therefore, 162 mm.^{2}. Round this, for reasons explained later, is a close-fitting lead tube, the outer diameter of which is 18 mm. The insulation is built up as follows:—

	Thickness in mm.	λ
First layer. Rubber	2·5	6·1
Second layer. Rubber	2·3	4·7
Third layer. Rubber	4·5	4·2
Fourth layer. Impreg. paper	5·2	4·0

The total thickness of the insulation is, therefore, 14·5 mm. ($b/a = 2{\cdot}61$), and the cable is lead-covered.

If R, R′, R″ and R‴ be the maximum electric stresses on the four layers when the applied pressure is 150 kilovolts, we find by the formulæ given in Appendix A, R = 124, R′ = 132, R″ = 123, R‴ = 97·4 kilovolts per centimetre. If a dielectric of homogeneous substance had been used, the maximum electric stress would have been 174 kilovolts. Hence the grading has reduced the maximum electric stress by about 24 per cent. If air had been the dielectric, a disruptive discharge would have ensued at 23 kilovolts.

Mervyn O'Gorman has shown that to get uniform electric stress we must have at all points in the dielectric λr = constant, where λ is the dielectric coefficient and r the distance of the point from the axis of the cable. He suggests that by suitably "loading" paper insulation an approximation to this ideal cable might be constructed.

When applying direct voltage suddenly to a cable, it has to be remembered that the value of the stresses initially may be quite different from their value after the steady state is reached. In a cable, the dielectric of which consists of different insulating wrappings, the relative values of the voltages between each of these wrappings will initially be inversely as the capacities of the condensers formed by the inner and outer layers of these wrappings, but when the steady state is reached these ratios are as the resistances offered by the wrappings to a radial flow across them, and hence the stresses may be quite different in the two cases. It is therefore advisable to apply the direct pressure to a cable gradually.

The British Standard Radial Thicknesses for Jute or Paper Dielectrics.—The nominal area of the cross-sections of the conductors and the radial thicknesses ($b - a$) of the dielectric for concentric cables given in the following table are taken from a report issued by the Engineering Standards Committee (E.S.C.) in August, 1904 (p. 8):—

S.	a.	660 volts.		11,000 volts.	
		$b - a$.	R_m.	$b - a$.	R_m.
Sq. in.	In.	In.	kv. per mm.	In.	kv. per mm.
0·025	0·089	0·08	0·64	0·35	4·3
0·050	0·126	0·08	0·59	0·35	3·7
0·075	0·155	0·08	0·57	0·35	3·3
0·100	0·178	0·09	0·50	0·36	3·1
0·125	0·199	0·09	0·49	0·36	3·0
0·150	0·219	0·09	0·49	0·36	2·9
0·200	0·253	0·09	0·48	0·36	2·7
0·250	0·282	0·10	0·43	0·37	2·6

In the above table s represents the cross-sectional area, a the radius of the cylindrical conductor whose cross-sectional area is s, $b - a$ the thickness of the dielectric given by the E.S.C., and E_m the maximum working electric stress when the amplitude factor of the applied alternating pressure is $\sqrt{2}$.

It will be seen that the electric stresses on the dielectric are very different in the high-pressure cable from what they are in the low-pressure cable, and the dielectrics in cables of different sizes are subjected to appreciably different stresses.

In the first five of the high-pressure cables the dielectric surrounding the high-pressure conductor will begin to be broken down before the disruptive discharge takes place, because in these cables the ratio of b/a is greater than ϵ (2·718). The specified thicknesses, therefore, are not economical. Take, for instance, the main in which the nominal cross-sectional area of the conductor is 0·025 sq. in. With a solid cylindrical conductor a equals 0·089 in., and b is, therefore, equal to 0·35 + 0·089 = 0·439 in. Thus b/a = 4·92. If we make the inner conductor hollow and a = 0·142 in., b = 0·3865 in., we get the same maximum stress on the dielectric, but its thickness has been reduced by 33 per cent. and the outer radius by 12 per cent. As the armouring, &c., would also be substantially reduced, the cable would be less costly. If we merely kept b = 0·439 in., but increased a to 0·1616, so that $b/a = \epsilon$ nearly, then the carrying capacity of the cable would be nearly quadrupled, the thickness of the dielectric diminished 20 per cent., and the maximum electric stress would have been reduced to 3·8 kilovolts per millimetre.

In order to simplify the formulæ for the electric stress, we have assumed that the inner conductor is a smooth cylinder. In practice the inner conductor is nearly always stranded, and the effect of this is generally to increase the maximum stress on the inner dielectric by about 20 per cent. It is worth while, therefore, to prevent this increase in the stress on the inner wrapping by making the surface of the conductor smooth. This can be done by covering, as Jona does, the inner conductor with a thin lead tube. For extra-high-pressure cables the gain in the strength is well worth the slight increase in the cost of the cable.

In Appendix A are given formulæ for the grading of single-core cables; and in Appendix B the thermal conductance of the dielectric is dealt with.

LEGAL.

Patent Revocation Appeal Case.

[*In the matter of the Patents Designs and Trade Marks Acts*, 1883 *to* 1888 *and in the matter of Letters Patent No.* 14,006, *of* 1903, *granted to J. N. Alsop.*]

This case came before a Divisional Court, consisting of the Lord Chief Justice and Lord Justice Buckley, on Tuesday.

Mr. J. C. Grey said the application was that one of the respondents to the petition (one of the appellants to the appeal) should be allowed to withdraw from the appeal, the petition for revocation for patent. The respondents to the petition were a company which was re-constructed, and also the old company. The liquidator of the old company refused to be a party to the appeal unless he was properly secured for his costs. In these circumstances, he (counsel) applied that the old company should be allowed to withdraw from the appeal. The reconstructed company were prepared to pay the old company's costs of the appeal up to November 1st.

Mr. Colefax, for the petitioners, said he would agree to the application if the old company would pay the costs of the appeal up to that day. He was instructed that the old company had got all the money.

Lord Justice Buckley suggested that the proper order was that the old company might be allowed to withdraw from the appeal on paying the costs of the appeal up to that day, but those costs were to be in the discretion of the Court when the appeal was heard.

Mr. Colefax: I agree to that, and that those costs will include the costs of the motion to-day.

The Lord Chief Justice: Yes.

Edinburgh Electricity Works Assessment.

In the Edinburgh Court of Session (Outer House), before Lord Dundas last week, the case was heard of the City of Edinburgh *v.* Parish Council of Edinburgh and Another. According to a report in the *Scotsman*, this is a suspension by the Lord Provost, Magistrates and Council of the City of Edinburgh of a threatened charge by the Parish Council of the City Parish and their collector for the unpaid balance of an assessment levied upon the complainers by the respondents for the year from Whit Sunday, 1905, to Whit Sunday, 1906, in respect of the subjects forming their electric lighting undertaking. The question involved was as to the proper amount of deductions to be made from the annual value of the undertaking as appearing in the Valuation Roll for the purpose of making the assessment for Poor Law and School Board purposes, under Sec. 37 of the Poor Law (Scotland) Act, 1845. The respondents fixed 24 per cent. as the amount of deductions to be made for the year in question. A deduction at that rate amounted to £14,861 10s. 4d. For the year 1904-5 the amount of the complainers' actual expenditure was £10,433 0s. 8d. The complainers maintained that the proper amount of the deductions was 64 per cent., which would amount to £38,392 5s. 2d. There was only one item as to which the parties were in dispute. The complainers claimed a deduction for "the probable annual average cost of the repairs and other expenses necessary to maintain the subjects in their actual state—£34,802 4s. 4d." The respondents averred that "the complainers are not entitled to deduction of any sum to meet the cost of replacing buildings, nor to any deduction in respect of the renewal or repair of machinery, plant, &c., other than such sum as represents the probable annual average cost thereof, so far as the same has been actually paid in past years, and so far as such expenditure is necessary for the maintenance or repair of machinery, plant, &c., which is of a perishable nature and liable to become worn out. The complainers, in striking the probable annual average cost of such repairs and other expenses for the purposes of that deduction, are not entitled (as they propose to do) to take into consideration the probable cost thereof in future years." The complainers, on the other hand, explained that a very considerable amount of depreciation was constantly going on in their machinery, plant and mains, which rendered it necessary for them to pay and provide large sums to keep the undertaking in proper repair.

Lord Dundas said he would remit to a man of skill to consider and report with special reference to the statements and pleas of parties as to the annual probable cost of the repairs, insurance and other expenses, if any, necessary to maintain the complainers' subjects assessed in their actual state, and the rates, taxes and public charges payable in respect of the same, it being the object of the remit to ascertain the deductions to be made in terms of the 37th Sec. of the Poor Law Act, and to report upon any other matter which either party may consider material to the question at issue. All questions of expenses were reserved, and leave was granted to reclaim.

The Poole Tramway Assessment Appeal.

The hearing of the appeal by Bournemouth Corporation against the assessment of £1,850 upon the Poole Tramways, of which Bournemouth are the lessees, was concluded at a sitting of the Poole Quarter Sessions, in London, before Mr. Clavell Salter, K.C., on November 2nd.

Mr. Wm. P. Ryan, civil engineer and surveyor, said he was of opinion that about £3,000 was the rateable value of the undertaking. That was what he thought a hypothetical tenant would pay. He had heard that the lower road was worked at a dead loss, but that did not affect his valuation, as it was a great convenience to the inhabitants, and on that account a Corporation should willingly pay on it. Considered parochially, he admitted that this did affect the value, but that was a wrong basis for calculation.

Mr. W. Andrew, architect and surveyor, placed the rateable value of the undertaking at £2,380. The population had increased largely of late years.

Mr. Cecil Barber, manager of the Bournemouth Corporation tramways, recalled for cross-examination, said that the service in Poole rendered the use of a larger supply of electricity necessary, and by this use of larger quantities of electricity, lower terms per unit were obtained.

This concluded the evidence.

Mr. Foote, K.C., for Poole, said it was not the business of the Court to fix the rateable value of this property. If he were right at all, he was right because £1,850 was not too much, but was too little. Throughout this investigation his clients had proceeded on the strictest lines. He asked that the larger principle should be accepted.

The Recorder: What do you mean by the larger principle?

Mr. Foote explained that the principle they advocated was that where it was possible to ascertain the exact amount of receipts on any part they could take the average gross receipts, and in the present case they were justified in doing so, because one had a contributive value to the other.

Mr. Ryde argued that the rent actually paid to the owners could not be regarded as a basis of rateable value, because when the bargain was entered into, if the Bournemouth Corporation did not accept the terms offered to them the result would have been not only that they would have failed to become the owners of the Poole tramways, but would have failed to continue to be owners of their own tramway in Bournemouth. They would never have had the chance of again becoming the owners of their own tramway, for, as a matter of fact, the order had gone forth that the tramways were to be taken up. In that case the terms for the rent were no voluntary arrangement entered into by Bournemouth. Their eyes were opened, but their hands were tied.

The Recorder withheld his judgment until next sessions.

Taylor *v.* Manchester Corporation.

At the Manchester Assizes, on 7th inst., before Mr. Justice Pickford and a special jury, plaintiff, Edwin Taylor, a young man employed by Messrs. Ferranti, electrical engineers, claimed damages from the Manchester Corporation, for personal injuries caused by the alleged negligence of the defendants' servants. It was explained on behalf of the plaintiff, that he had narrowly escaped death by touching "live" wires (6,500 volts), at the Chorlton-cum-Hardy sub-station belonging to the Corporation. He was working in connection with the extension of a switchboard at the station, and was about to open a door in a panel, when he was drawn in by "live" bars. There was a flash and a report a of thunder, and he was held to the bars by the current; he wa

afterwards pulled away by his boots, and fell to the floor in a state of collapse. He was badly burned about the hand and right thigh.

The defence was that it was the plaintiff's duty to see that the board was safe.

Dr. Pownall, who attended the plaintiff after he had received the injuries, said he found plaintiff in a state of extreme collapse and pulseless. He injected strychnine, and subsequently attended the patient. He believed plaintiff owed his life to throwing out his hands, and a short-circuit being formed through his thigh. Had it touched the brain, death would have resulted. Since the accident plaintiff had suffered from periodical attacks.

The hearing was adjourned till the 8th inst. At the adjourned hearing, the Jury found for the plaintiff, and awarded him £250 damages. Judgment accordingly.

A Bury Tramcar Accident Claim.

At the Manchester Assizes last week a special jury awarded £65 damages to Cuthbert Hackworth, a trainer of greyhounds, who was injured on May 25th whilst travelling on a Bury Corporation tramcar. Mr. Ambrose Jones appeared for the plaintiff, and Mr. Sutton for the defendants.

The plaintiff said that as he was travelling on the day in question on a Bury car the door at the front fell forward, and was caught by his son. Later, when the car stopped, the same door fell on the plaintiff's head, and seriously injured him. It was contended that the defendants were liable for the defective condition of the door, and there was evidence that, after the accident, the guard of the car said it was "just what he expected." The plaintiff's sight and hearing were impaired, and he suffered from the effects of concussion.

For the defence, it was stated that the door could not have fallen if it had not been interfered with by one of the plaintiff's sons, though it was admitted to be "off its runners."

Judgment was given for the amount stated.

Taylor *v.* United Electric and Power Supply Co.

Before Vice-Chancellor Leigh Clare, at the Lancashire Chancery Court, at Liverpool, on Tuesday, November 12th, a motion was considered relative to the action of Taylor *v.* the United Electric and Power Supply Co., Ltd. The defendants are a company formed in 1901 to supply electric light and power, carrying on business in Manchester.

Mr. Cunliffe applied for the appointment of a receiver and manager on behalf of the plaintiff, a debenture-holder, whose debt was £475, as against a total issue of debentures of £2,800. The plaintiff's debt had become at once payable owing to the failure of the company to pay interest. Counsel stated that the company's principal assets at present consisted of land and plant at a town with an unpronounceable name, in Portugal. Proceedings there were pending against the company, directed against the assets, and it was important that they should be protected as early as possible.

His Honour agreed to the application for the appointment of a receiver and manager, and gave liberty to apply for leave to the receiver to appoint an agent in Portugal.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

"Owner" writes: "Before the urban council existed, I supplied electric light to a small town. My wires are mostly run overhead by leave of house-owners. The urban council now say that as I had not their leave to open the street or erect wires, the supply must cease.

"Have they the right to cut my wires, as they own the gas-works?

"Would the law be the same in Scotland or Ireland as in England?"

*** Speaking generally, an urban council has no power to interfere with overhead wires unless it is shown (*a*) that the council owns the soil of the highway; or (*b*) that the wires are suspended so low that they are likely to interfere with the traffic. So long as they are on private ground (and do not violate the Board of Trade regulations) the urban council cannot touch them. As to the lines already laid underground, these cannot be touched, although the council might certainly prevent the surface of any street being uprooted again. Broadly speaking, it may be said that the law on this subject is the same throughout the United Kingdom.

Dunfermline.—The T.C. on Friday decided by nine votes to eight to seek the advice of Sir Alexander Kennedy as to whether the Council should establish a separate generating station, take a supply of energy in bulk for the Fife Electric Power Co., transfer the prov. order to that company, or allow the order to lapse.

BUSINESS NOTES.

South American Markets.—The *Electrical Record* (U.S.A.) publishes the following quotation from an interesting and instructive report recently made by Mr. Edmond A. Burrill, vice-consul at Puerto Cabello, Venezuela, after a study of trade conditions in South America in general, and of how to make new markets for exporters. He says that one scheme of spreading information to those who may become interested in the purchase of American (our readers may imagine the word *English* here) goods has been overlooked. This he explains thus:—

At present merchants are using two methods in their endeavour to get foreign business. The first is the sending out of agents, and the second is the sending out of catalogues and advertising matter, &c., as a means of acquainting the buyers with their wares.

As to the first method, all merchants who do, or contemplate doing, a foreign business should know by this time that the best method for getting foreign business is to send an agent who will take a full line of samples and study the market, paying special attention to the tastes and customs of the consumers. He should be one who knows trade possibilities, knows how to speak the language of the country to which he is sent, and, above all, knows the courtesy and civility which are possessed by the salesman of other countries.

As to the second method, which is employed to a considerable extent by our merchants and manufacturers who desire to enter the export trade, and who will not, or cannot, send representatives, trade magazines, business directories, catalogues, and advertising matter could be made more efficient and more telling. It is suggested that instead of sending these in English solely to consulates, they should be printed in the language of the country in which they are to be distributed, and sent also to the various reading rooms and libraries of all clubs, commercial and otherwise; merchants' associations, boards of trade, chambers of commerce, and similar organisations, which usually have such rooms and are frequented by a large coterie of buyers.

This suggestion applies especially to those who now publish magazines in a foreign language and send them gratis to consulates. Consuls would be glad to furnish the names of such clubs and associations in their districts. Whenever it became generally known that the reading rooms of these places contained valuable commercial information, it would doubtless inspire interested parties to seek them out from time to time. Such institutions are eminently better fitted than the consulates for distributing information of this kind. Business men come rarely to the consulate, even to see those magazines printed in the language in which they can read, presumably on account of a lack of time. They are usually too much occupied to leave their establishments during business hours. It is reasonable to suppose that frequently when advertising matter is sent directly to firms it is laid aside for leisure moments and forgotten.

In the clubs and association reading rooms men have the time and the inclination to give thoughtful attention to what they read, especially on matters of interest to them; whereas during business hours advertising matter is less likely to make a serious impression. It appears that without considerable effort a trade might be built up in this way, particularly in those lines that would not warrant the presence of a commercial agent.

When catalogues and descriptive advertising are sent they should contain a sufficient amount of intelligent detailed information to make them of value, and it should be so full as to leave no opportunity for questioning; otherwise it seems to be a waste of time and a needless expense to bother about sending them. Besides being in the language of the country to which they are sent, they should contain prices quoted in the currency of that country. The net weight and gross weight of the merchandise when ready for shipment, as well as the dimensions, should be stated in the metric system, or the system in vogue in the place of distribution. The tariff duties and freight rates should come in for a share of attention as well. It would be well, also, to state that goods will be packed strictly according to directions. It is, of course, needless to say that when they are shipped they should conform absolutely to representations, or be a little beyond them, if it is possible. Such information as regards language, currency, tariff duties, system of weights and measures, and freight rates can be easily obtained from the proper sources. In fact, there are reputable institutions created for the sole purpose of promoting American export trade that can supply all of this information, or it may be obtained from the Consuls in the countries to which the advertising matter is to be sent. Mr. Burrell adds:—

"Those who wish to get business through illustrated catalogues and advertising matter without the proper kind of selling agent in person should see that every minute detail is properly presented, especially so in these times of keen competition for the control of the world's markets. This is the system that is employed with good results by the houses of other countries, and there is no reason why American houses should not do the same."

A list of Venezuelan clubs and merchants' associations in Puerto Cabello, Valencia, and Barquisimeto is filed for reference at the Bureau of Manufactures, at Washington, D.C.

Trade Announcements.—The Perfecta Seamless Steel Tube and Conduit Co., Ltd., inform us that they have appointed Mr. G. E. Sare, late of Messrs. Fals, Stadelmann & Co., Ltd., as their London manager. As already stated, their new offices are at 64, Victoria Street, S.W., where large stocks are kept.

Messrs. Roberts Bros., electrical engineers, late of 15 and 17,

Lee Street, Bradford, have removed to their new show-rooms, at 21, North Parade, Bradford. Fittings manufacturers and supply houses are invited to forward new lists and catalogues.

The Stearn Electric Lamp Co., Ltd., of 47, Victoria Street, Westminster, London, S.W., have acquired the British and Colonial business and goodwill of the Zurich Incandescence Lamp Co. The *personnel* and business generally will be absolutely unchanged. All debts due to the London branch of the Zurich Co. are to be paid to the new company, and all debts owing by the London branch will also be settled by them. The Stearn lamps will continue to be made, as at present, only at the works at Kew Gardens, London, by British labour.

Messrs. T. W. Broadbent, Ltd., is the name of a new company that has been formed to take over the electrical engineering business carried on by Mr. T. W. Broadbent at the Victoria Electrical Works, East Parade, Huddersfield. The capital of the company (£5,000) has all been privately subscribed. The first directors are T. W. Broadbent; G. A. Broadbent; and F. W. Davies. We understand that the company will devote special attention to three-phase driving installations, and will take up the manufacture of three-phase motors and starters on a larger scale. The manufacture of the D type dynamos and M type motors, also the N type and R type single-phase motors, and other of T. W. Broadbent's specialities will be carried on as hitherto.

The Electromobile Co, Ltd., have moved into their new offices and garage at 7, Hertford Street, W. The garage has accommodation for 300 carriages, and is, it is claimed, the largest ever erected in a residential centre. On Tuesday last a reception was held to inaugurate the new garage, which was largely attended. The electric carriage is indisputably unexcelled for town locomotion, and possesses the *entrée* to Hyde Park when other automobiles are excluded. The arrangements at the Electromobile garage for the care of batteries and carriages are most complete.

Condensing Plant Contracts.—The Mirrlees Watson Co., Ltd., Glasgow, have recently received orders for a number of condensing plants, amongst which are the following:—

City of Glasgow Tramways Department.—Surface condensing plant dealing with 50,000 lb. steam per hour, for 28½ in. vacuum. The plant will be working in connection with a Richardsons-Westgarth steam turbine; also two sets of motor-driven boiler feed pumps.

Gloucester Railway Carriage and Wagon Co., Ltd.—Surface condensing plant for working with steam turbine dealing with 10,000 lb. steam per hour, 28 in. vacuum.

Fraser & Chalmers, Ltd.—One set of surface condensing plant working with steam turbine.

Bankruptcy Proceedings.—Maunsell Mercier, Salford.—The public examination in this bankruptcy was conducted before Mr. Registrar Addie at the Salford Bankruptcy Court on Tuesday. Debtor's statement of affairs showed liabilities amounting to £4,679, against which there were no assets; the causes of failure were stated to be expenditure on patents which proved to be of no value, to travelling and other expenses in endeavouring to exploit the sales of industrial and mining properties which had produced no return, and to law costs of writs and summonses. In reply to the Official Receiver (Mr. J. Grant Gibson), debtor stated that during the past seven years he had acquired several patents, the chief being patents for submarine mines for coast defences, electric traction for canals, and rail-less traction for roads. He had expended a large amount in the unsuccessful endeavour to make money out of them, and the patents had now lapsed. Admitting that he first became aware of his insolvency in 1897, debtor said he had contracted debts since then in the hope that some of his patents would have turned out profitable, and that he would have reaped substantial commissions from the sales of properties he hoped to negotiate. The Official Receiver pointed out that almost all the debts of any size had been incurred since 1900, and that, *prima facie*, such debts were statute barred. Of course, no assets were shown; that was not very material at present, but if assets should come to hand the case might be different. The examination was adjourned.

Catalogues and Lists.—Mr. G. Braulik, London, E.C.—New illustrated catalogue of electric light fittings and glassware. Numerous designs of hand lamps, counterweight fittings, brackets, pendant fittings, electroliers, table and floor standards, outside fittings and other lines, are shown and priced. A variety of accessorial parts for the above, and many specimens of shades, are included, and prices are given.

Messrs. Robert A. King & Co., of 66, Victoria Street, Westminster, S.W.—A bulky collection of their illustrated pamphlets and price lists. From these we note that, in addition to their ordinary business of new and second-hand machinery merchants, the firm hold several agencies for electrical and other supplies. They now represent the following firms:—Messrs. Millen & Sommerville, of Tradeston Ironworks, Glasgow, constructional engineers, manufacturers of steel roofing, girder work, forgings, &c., and the Comet oil flare lamps for contractors; Messrs. Smithson, Sharpe & Co., of Hulme, Manchester, makers of arc lamps, carbons and resistances; Messrs. Laurie & Co., West End, Falkirk, makers of Laurie & Inglefield's patent system of travelling electric lights and stretching pendants. Among Messrs. King's other lists received are some relating to motors, dynamos, steam sets, fans, &c., which are made by a North of England firm.

From Mr. Howard Ryland, of 217, Bradford Street, Birmingham, we have received some specimens of aluminium pens.

The Brush Electrical Engineering Co., Ltd., Loughborough.—"The Book of the Brush Engine" is the title of a new, beautifully got-up publication, in which appear a variety of half-tone views of the Brush high-speed steam engine for electric generating plant, showing combined sets of from 80 up to 750-kw. capacity. A fully illustrated and detailed specification of the Brush enclosed-type engine is included, and a brief specification of the company's standard electrical plant follows that. The front cover bears a reproduction in colour "In the Power House," "from a painting by E. R. Fox."

Messrs. Pooley & Austin, 25, Victoria Street, S.W.—New eight-page illustrated price list of the "Phictoria" electric incandescent lamps.

Standard Metal Engraving Co., 24, Holborn, E.C.—Cards showing their flexible metal name-plates, and containing a small calendar up to the middle of 1908.

Messrs. Gilbert Gilkes & Co., Ltd., Kendal.—New catalogue of their turbines, Pelton wheels and other hydraulic machinery. The book is entitled "On the Development of Water Power." General information interesting to those who are concerned with water power utilisation is followed by descriptive particulars of their double and single vortex, single discharge, Girard (vertical or horizontal shafts), Trent, Lunedale, Little Giant, and other turbines. The illustrations, which are in half-tone, are admirably printed, and the matter is all neatly arranged.

The Abbey Electric Co, 17, Victoria Street, S.W.—Leaflet drawing attention to their "Abbey" flame arc lamp.

Messrs. Johnson & Phillips, Ltd., Victoria Works, Charlton.—Four-page circular giving illustrated information, also a list of prices, relating to their vertical carbon flame lamps.

Messrs. Edward Wood & Co., Ltd., 88, Cannon Street, London, E.C.—Catalogue showing many line and photographic illustrations of their steel structures, including a number of buildings erected by them recently at home and abroad. Among these we find West Ham and Manchester tramway car depôts, Salford electric generating station, various warehouses, mill buildings, factory premises. Their standard designs of roof trusses, stanchions and girders, which are shown, are claimed to be particularly adapted for workshop construction.

The Premier Electric Heating Co., Ashley Street, Birmingham.—In this 16-page catalogue the company introduce a number of original designs of their electric heaters in antique copper and hammered iron. Some luminous radiator types are also shown, as well as the company's flat-irons, tin-plate and copper kettles, water heaters, hot-plates, foot-warmers, and accessories. Particulars of prices are given.

Dissolutions and Liquidations.—Electrical Publishing Co., Ltd., 4, Southampton Row, London.—At a meeting held on October 31st it was resolved to wind up voluntarily as the company cannot, by reason of its liabilities, continue the business. Mr. J. H. Moritz, 8, Queen Street, Cheapside, is liquidator.

International Telescriptor Syndicate, Ltd.—This company is winding up voluntarily.

The Aluminium Syndicate, Ltd.—This company is winding up voluntarily, with Mr. D. C. Jolley, 1, London Wall Buildings, E.C., as liquidator.

Smoke Abolition Syndicate, Ltd.—A meeting is to be held at 45, Goldhawk Road, Shepherd's Bush, W., on December 11th, to hear an account of the winding up, from Mr. W. H. White, liquidator.

Forrest, Ellinthorpe & Co., steam boiler and piping coverers and cement merchants, Catherine Street, Preston.—Messrs. J. S. Rich, J. B. Forrest, and G. W. Ellinthorpe have dissolved partnership. Mr. Rich will attend to debts, &c., and continue the business.

Neville, Williams & Co., electrical and general engineers, contractors, and agents, 11-13, Southwark Street, S.E.—Messrs. C. E. Newton, and Percy & E. A. Good have dissolved partnership. Debts, &c., will be attended to by the Messrs. Good, who will continue the business under the old style.

British Electric Equipment Co., Ltd., London.—December 2nd is the last day for receipt of proofs for intended dividend. Mr. H. de Vaux Brougham, liquidator, 33, Carey Street, W.C.

Patent Electric Carbonising Co., Ltd.—A meeting is to be held on December 18th to hear an account of the winding up from the liquidator, Mr. M. S. S. Roberts.

Sandgate and Hythe Electric Co., Ltd.—A meeting is to be held at the London Wall Buildings, E.C., on December 16th, to hear an account of the winding up from Mr. D. C. Jolley, liquidator.

Calverley, Batty & Co., electrical engineers, 27, Market Street, Burnley and Nelson.—Messrs. G. H. Calverley and J. Batty have dissolved partnership as from August 6th.

Messrs. E. & H. Sames, electrical engineers, plumbers, &c 10, Newcomen Street, Southwark, and Bermondsey.—Messrs. E C Sames and H. Sames have dissolved partnership. Debts, &c wil. be attended to by E. C. Sames.

Book Notices.—"Load Test of Floors. Three Floor Slabs of Reinforced Concrete on the Herbst Armocrete Tubular System." "Red Book" of the British Fire Prevention Committee. No. 125. London: British Fire Prevention Committee. 1907. Price 2s. 6d.

"Coal." By J. Tonge. London: A. Constable & Co., Ltd. 1907. Price 6s. net.

"Town Gas and Its Uses." By W. H. Y. Webber. London: A. Constable & Co., Ltd. 1907. Price 6s. net.

Argentine Republic.—The Argentine *Boletin Oficial* for September 23rd contains a law conceding to the Municipality of Posadas (Misiones) exemption from Customs duty on machinery and material for the electric lighting of the Municipality up to a sum not exceeding 500 pesos gold.—*Board of Trade Journal.*

LIGHTING and POWER NOTES.

Aylesbury.—Being satisfied that the delay in commencing the work of establishing electricity works in the town by the Mutual Electricity Supply Co. has been due to some extent to circumstances beyond their control, and on the company undertaking forthwith to complete the transfer, and to proceed with the work without delay, the U.D.C. has decided to request the B. of T. not to revoke the E.L. order, and to grant a reasonable extension of time.

Canada.—WINNIPEG.—The Mayor has vetoed a resolution passed by the Council, accepting the offer of a British syndicate to construct a water-power electric scheme at a cost of $2,500,000.

Caermarthen.—Messrs. J. B. Saunders & Co. are applying for electricity supply powers in the borough. See *London Gazette* November 8th for full notice of application.

Cheltenham.—The T.C. has decided to supply energy for the tramways at 1·6d. per unit for the first 425,000 units per annum, delivered in bulk at the Manchester Street sub-station, 1·1d. per unit for the next 200,000 units, and ¾d. per unit for all above 625,000 units, which is to be the minimum annual consumption.

Chertsey.—The Woking Electric Supply Co., Ltd., has asked the R.D.C. to consent to a new application for powers to supply electricity at Thorpe.

Colne.—The T.C. has received from the L.G.B. sanction to a loan of £4,000 for additional generating plant, and £1,500 for mains extensions.

Continental Notes.—FRANCE.—La Société l'Energie Electrique du Nord de la France has secured a 30 years' concession for the electric lighting of the town of Ronliaux.

ITALY.—Engineer Luigi Zanetti is asking for the right to utilise water power where 10,000 H.P. is available on the river Coltenna. The turbines will work with a head of 304 metres.

Dundee.—The management of the public lighting has for many years been in the hands of the Gas Committee, and Mr. Richardson recently pointed out to his committee the incongruous manner in which this had been handled by the Gas Committee. As a result of this, the Town Council has decided to appoint a new committee to be called the Public Lighting Committee, consisting of three members each from the Electricity, Gas and Police Committees, an arrangement which, it is believed, will ensure far greater efficiency in the matter of street lighting.

Elland.—The U.D.C. has decided not to take over the E.L. order possessed by Greetland U.D.C., or to distribute in the latter's district, but offers to supply electricity in bulk at the Elland boundary at the lowest possible price.

Finchley.—The U.D.C. is asking Parliament for increased powers in regard to the electricity undertaking. At the meeting on November 7th, it was proposed that the electric lighting area be extended to include Friern Barnet. The Chairman of the Finance Committee suggested a still further extension to include the Willenhall estate. In the result it was decided to include in the proposed Bill Friern and Torrington Parks and Friern Barnet, but not the Willenhall estate.

Fleetwood.—The offer of the District Council of £12,000 for the whole undertaking of the Fleetwood and District Electric Light and Power Syndicate has, we understand, been rejected. The company declines to fix a price, but is desirous of submitting the matter to arbitration. The business of the company has, of late years, made material progress, and last year a profit of £1,000 was disclosed, as against £170 in 1905.

Hendon.—The *London Gazette* for November 12th contains notice of the intended transfer to the Hendon Electric Supply Co., Ltd., of the 1899 and 1903 E.L. orders obtained by Messrs. Crompton & Co., Ltd. The Electric Supply Corporation recently appointed Mr. B. G. Drummond as resident engineer and manager, and is making considerable progress in the laying of cables. It is hoped that by the end of the year, or early in 1908, the company will be in a position to supply current.

Japan.—A project is being supported by prominent men in England and Japan to exploit the water power of Japan. Some 300,000 H.P. can be obtained within 150 miles of Tokio, where the present requirements are 48,000 H.P., and some 20,000 H.P. additional is wanted. A large power-producing district is situated some 160 miles from Osaka, the Manchester of Japan. Numerous electric tramway and railway projects, and the high cost of coal, will facilitate water-power development.

Liverpool.—A L.G.B. inquiry will be held on the 26th regarding the application of the Corporation for sanction to borrow £200,000 for purposes connected with the supply of electrical energy.

London.—HAMMERSMITH.—In connection with the Franco-British Exhibition, the Electricity Committee of the B.C. has decided (subject to tests proving satisfactory) in favour of purchasing two sets of secondhand motor converters, each of 400 KW., from the Newcastle-on-Tyne Electric Supply Co., for £600. The lowest price quoted for one similar converter, new, was £1,316.

ISLINGTON.—The re-constructed Canonbury Tower is to be lighted with electricity, and low-pressure distributing mains are to be laid thereto by the Council at an estimated cost of £125. Application is to be made to the L.C.C. for sanction to borrow £6,935, the cost of providing and laying mains and connecting consumers' premises during the year ended March 31st, 1907.

POPLAR.—The cables crossing the London and India Docks at Limehouse have been damaged. In order to avoid the expense of repairing them, which would be recurrent, it is intended to erect a girder bridge, similar to that carrying the high-pressure cables, and to replace the existing 28 single cables by four five-core cables. By this method the cable will be made easy of access in case of damage, thus saving the heavy cost of diving operations. The total estimated cost of the work is £70.

Monmouth.—At a L.G.B. inquiry on the 6th inst. into an application by the Corporation for sanction to borrow £10,000 to defray electric lighting expenses incurred, it was admitted that certain work had been done two or three times over, and money had been paid without proper investigation. It was stated that money had been paid on the certificate of the engineer, but the officials could not show how the expense had been incurred. Cables for electricity had been laid in certain streets, though no customers were forthcoming, and the cables had to be taken up again. The Inspector described it as extravagant waste, and said it was no wonder the undertaking did not pay on such lines. The inquiry was closed.

Montrose.—The T.C. on Friday decided to accept the offer of the North of Scotland E.L. Co. for public lighting for four years at £850 per annum.

Scottish Water-Power Scheme.—It has been decided to ask Parliament for powers to proceed with a new scheme in the Highlands. What is intended is to dam the river Awe in Argyllshire, erect works, and convey the power by cable to a factory to be erected for the production of ferro-silicon by means of electric furnaces. The dam will be thrown across the river about midway between the Pass of Brander and the bridge which carries the public road across the Awe. At this point the level of the river is about 107 ft. above sea level, and the average level of the loch is 118 ft., the highest recorded level being 128 ft. The coping of the dam is to be 122 ft. above sea level. As loch Awe from which the river flows is a very long and narrow sheet of water, with a catchment area of 300 sq. miles, it is not considered that the proprietors' rights in the loch will be injured by the formation of a dam. The flow of water down the river during the greater part of the year is more than is required for angling purposes. From the dam the water destined for power purposes will be conveyed by an open canal for two miles, and thereafter led through steel pipes to the power house. This house will be placed on the low ground near Bonawe Ferry; but the factory will not be there. A site on Achnacree Moss between Benderloch and North Connel stations on the Ballachulish Railway has been selected for the factory, for the reasons that peat for charcoal will be obtained in abundance there, and that both railway and shipping facilities already exist. To convey the electric power from the power house to the factory, a cable will have to be laid across Loch Etive, and thence an overhead cable will have to be carried a distance of 10 miles. Compared with the great Loch Leven scheme, now well advanced, the engineering plans of the Awe contracts appear to be comparatively simple.

Sheringham.—The U.D.C. has referred to a Committee the question of E.L. for the town. It is understood that a private person will form a syndicate for the purpose of applying for a prov. order, if the Council decides not to take a similar step.

Stockport.—The T.C. has adopted the following scale of charges for energy:—Lighting, a flat rate of 3½d. per unit; power and heating, a flat rate of 1½d. per unit, or an alternative rate of £2 per annum per H.P. installed, and a flat rate of ¾d. per unit for energy.

Sunderland.—The shipbuilding depression is causing a little uneasiness in Corporation circles in the town. At a meeting of the Electricity and Lighting Committee, the chairman called attention to it. He said that after considering the estimated output in the light of the present bad state of shipbuilding, it was desirable to sound a note of warning that the Committee could not reasonably expect the estimates to be fulfilled as far as the output for shipyards was concerned. If the output was short the revenue would also be short, and the profits would be proportionately reduced.

Swansea.—The Corporation, in anticipation of a largely increased demand for electric power from works (especially from the Mannesmann Tube Co., Landore), will probably soon have to face the question of extending its electricity works. It is understood that proposals are under consideration which will involve a further capital expenditure of £30,000 for new buildings and machinery.

West Africa.—ANGOLA.—A concession was granted last year to an Italian engineer for the lighting of Benguela, Catumbella and Lobito with electricity, and the Vice-Consul at Benguela now reports that a British syndicate has taken over the concession. The numbers of lamps of the respective towns were fixed at 100, 300 and 100 for the first year, for which payment was to be made at the rate of 13,500 reis (£2 15s. 6d.) per lamp, the municipalities retaining the right to increase or decrease the number of lamps after the expiration of that period. The motive power is to be obtained from the Catumbella River, at a point four miles above the town of that name.—*Commercial Intelligence.*

Windsor.—The Board of Guardians, after debating amongst themselves for a long time as to the respective merits of gas, oil, acetylene, and electric lighting for their workhouse, have decided now to call in an expert engineer to give them advice upon the subject. In addition to the lighting problem, the expert will be asked to define the best scheme for heating and for getting a water supply.

Woodbridge.—The U.D.C. has accepted the terms of the Suffolk Electricity Supply Co., Ltd., to light the town by electricity for £350 per annum, for seven years, with Osram lamps.

Worcester.—The Corporation recently held an Exhibition, at which examples of the most recent types of heating, cooking, lighting and power apparatus were on view. The electricity station was thrown open for public inspection at the same time, and some 10,000 persons availed themselves of the opportunity of viewing their own concern.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the meeting of the Tramways and Electricity Committee on the 11th inst., a letter was read from Messrs. M'Lean & Sons, solicitors, intimating that their clients were making arrangements for constructing the tramway line between Holywood and Belfast, and asking for an interchange of traffic, and a quotation for supplying power to the proposed new system. The Committee unanimously decided not to give the Holywood Co. powers to run over the Corporation lines, but to supply energy at a rate to be fixed. The town clerk stated that he was about to take steps to have a Bill promoted in the House of Commons for the purchase of the Cavehill and Whitewell Tramway undertaking, which the Corporation has decided to acquire.

Continental Notes.—GERMANY.—At the present time various schemes for the construction of electric railways are engaging attention in Berlin. In the first place, the short experimental length of the suspended railway, which the Continental Co. for Electrical Enterprises is erecting in the Brunnen Strasse for the purpose of showing how this particular method would appear if a concession were granted for a practical line between Gesundbrunnen and Rixdorf, is approaching completion, and the municipal council should soon be in a position to decide whether this scheme should be sanctioned—a project which has been pressed for consideration for about ten years. The Berlin Underground and Elevated Electric Railway Co., which recently opened a new station at the Leipziger Platz, and which has to complete by 1915 the extension to the Alexander Platz and the Schonhauser Allee, has already begun to make preparations with a view to further prolongations of its system. The Alexander Platz has been selected as the central and starting point for the proposed extensions, which comprise the construction of several combined high-level and underground lines in the north and north-east of the city, the elevated sections being in the outer districts. Associated with the schemes is the Siemens & Halske Co., which built or equipped the railway company's existing lines. In addition to these proposals the Allgemeine Elektrizitäts Gesellschaft, as briefly mentioned in a previous issue, has appeared on the scene with a project for the establishment of a combined underground and high-level railway between Gesundbrunnen and Rixdorf, of a total length of eight miles. One mile and a half would be underground, and the remainder of the railway would be elevated; provision is made for 15 stations, of which only three would be subterranean. It is proposed to construct the platforms of a minimum length of 142 yd., so as to render it possible to operate trains composed of five coaches. The total expenditure in establishing the railway is estimated at £2,750,000, and the cost of rolling stock would be £500,000. The question of priority of schemes occupies a prominent position with the local and other authorities concerned with public means of transport, seeing that projects first put forward have to be decided one way or another before later plans can receive official consideration when they relate to lines following the same routes. The A.E.G., on this basis, claims priority over the suspended electric railway scheme, as the company submitted a proposal for a complete network of electric railways for Berlin as far back as 1891, although the suspended line has now reached a more advanced stage, as previously mentioned.

SWITZERLAND.—It is announced that the Swiss Confederation, the Federal State Railways and the St. Gothard Railway Co. have concluded an agreement with the central authorities of the Canton of Uri in respect of water-power rights in that part of the country. The Government of Switzerland foresees the possibility of the substitution of electric for steam locomotion on the Federal railways, and as the country has no coal deposits at its disposal, the idea prevails that the interests of the nation require that the State should obtain possession, for the benefit of the community, of such water-powers as would come into consideration for the establishment of hydro-electric generating stations, so as to provide the electrical energy needed for the ultimate electrical working of the railways. The agreement now concluded represents a case in point. It confers upon the State the concession for 50 years to utilise the hydraulic power of the Reuss from the Trou d'Uri to Amsteg on payment of a single sum of £10,000 to the Canton of Uri and an annual rental of £2,880. The Confederation undertakes to reserve out of the total power available 7,000 H.P. for the Canton Uri and to furnish to the Communes the energy needed for electric lighting at cost price. This agreement and that which was entered into some time ago with the Canton of Tessin place the Confederation in possession of over 50,000 H.P., and thus assure the possibility of the introduction of electric traction on the St. Gothard Railway.

RUSSIA.—According to the *Standard's* correspondent, the powerful German electrical firms which have hitherto done most of the electrical work in Russia have now found a rival in the British firm of Bruce Peebles & Co., whose tender for the Moscow tramways has been provisionally passed by the municipality's executive, but awaits confirmation. The German firms have their own electrical works at St. Petersburg and Riga, and have combined in the present struggle to keep out British competition. As the Moscow municipality, like the rest of Russia, is at present hard pressed for money, it seems probable that the matter will turn upon the facilities respectively offered by the Berlin and the London money markets. The Mayor of Moscow, M. Nicholas Guchkoff, contemplates visiting London, where, among other matters, he will urge upon British attention the soundness of Russian municipal undertakings, and the large field offered by them for British investments.

ITALY.—The construction of the S. Quirico-Nostra Signora della Guardia Electric Railway, which has been suspended since 1900, is shortly to be resumed and completed.

A new project is to be formed for the construction of a line from Brescia to Gardone Val Trompia. The railway is to be electric and will be important, the existing tramway facilities being insufficient for the requirements of industry.

Erith.—The U.D.C. has decided to promote a Bill in opposition to the proposed L.C.C. tramways extension between Erith and Woolwich.

Gorton.—The U.D.C. has decided to make formal application to the B. of T. for a loan of £11,328, repayable in 30 years, to cover the cost of the construction of tramways in the district.

Halesowen.—As the result of a conference between a deputation of the Worcestershire C.C. and the property owners in Long Lane, Halesowen, respecting the proposed widening of that lane, which has delayed the settlement of the tramway scheme in the neighbourhood, the difficulties in the way have been removed.

Huddersfield.—During the past municipal year, in the tramways department, 3,594,444 units of electricity have been generated, which is an increase of 338,622 units over the previous year. The rolling stock consists of 70 cars and two electrically-equipped coal trucks. Sixty-four cars have been equipped with supplementary or rear-standing arrangements, and two additional cars have been fitted with new top covers, making a total of 35 covered cars. The work in connection with the repairs and maintenance department of the rolling stock has been transferred to the Great Northern Street depôt. The change has increased the efficiency of the work, considerably decreased the working expenses, and promoted the order and discipline of the staff. The system of through running has proved of great benefit to the public, as is shown by the increased receipts over the corresponding year, in spite of the very unfavourable weather experienced throughout the summer, and the fact that a reduction of fares also took place when the change was made. The traffic receipts amount to £73,964, which is an increase of £4,223 over last year. Additional plant has been installed at the power station, including new boiler, economiser and mechanical stoker, at a cost of £1,100.

London.—L.C.C.—At the meeting on Tuesday, the adjourned report of the Highways Committee was considered in relation to the recent decision to construct tramways from the existing lines at West Norwood to the Crystal Palace. The Committee had received representations from the Governors of Dulwich College, and from associations of residents of the localities concerned, the object being to suggest alternative routes to those proposed for the lines. After due consideration, the Committee decided to adhere to the routes already selected by the Council, and they recommended that no departure should be made from the decision to construct tramways in Chatsworth Road, Idmiston Road, Rosendale Road, Robson Road, Park Road, South Croxted Road, Dulwich Wood Park, College Road, and Farquhar Road to the Crystal Palace. The recommendation was, however, after discussion, referred back to the Committee by 50 votes to 40, for the purpose of further consideration.

The Highways Committee on Tuesday reported that the B. of T. had intimated its approval of the G.B. surface contact system of electric traction for the tramways from Aldgate to the county boundary at Bow Bridge. It was added that the execution of the work had been commenced.

A mishap occurred on the Central London Railway on the 10th inst., as a result of which the line between Marble Arch and Shepherd's Bush had to be closed to traffic from eight o'clock in the morning until after two o'clock in the afternoon. One of the electric trains running to Shepherd's Bush Station became partially derailed through one of the wheels fouling the points. The accident caused a short circuit in the district governed by the Shepherd's Bush sub-station.

Rawtenstall.—The T.C. has decided that during the present municipal year the construction of the electricity generating station, the taking over of the tramways, and the running of motor-'buses shall be dealt with at a cost of £140,000, made up as follows:—Parliamentary Bill, £4,000; electricity station and cables, £34,000; purchase and electrification of the tramways, £100,000.

Stretford.—For the quarter ended September 30th, the energy consumed by the City Corporation tramways reached a total of 326,443 units, which at 1¼d. per unit amounts to £1,700. According to the resident electrical engineer, this is the largest number of units consumed by the tramways for any one quarter. The District Council has before it a letter from the Manchester Corporation, enclosing a plan of an additional loop in Upper Chorlton Road, to be constructed on the renewal of the tramway along this route at an early date. In connection with this, attention has very rightly been called to the desirability of arrangements being made by Stretford with the Corporation to take over the supply of electricity for power purposes (at present tentatively supplied by Manchester) within the township in Chorlton Road and Upper Chorlton Road.

U.S.A.—San Francisco.—Serious rioting has occurred daily in this city owing to the strike of street-car employés and their replacement by strangers. The strikers have a partiality for revolvers, gas pipes, &c., and during the first four months of the present year accounted for 1,300 killed and injured, and during the second four months, 890. There have been killed during the past three months 32 persons.

Wolverhampton.—The annual report of the Tramways Committee to the Corporation states that the traffic receipts, &c., for the six months ending September 30th last, as compared with the same period last year, are as follows:—

	Miles run.	Passengers carried.	Receipts. £	R.P.C.M.
Electric cars—1907	495,114	4,931,409	23,068	11·182
1906	495,060	4,821,544	22,705	11·007
Motor-'buses—1907	28,883	272,110	1,303	10·824
1906	28,575	244,954	1,173	9·852

The total revenue for the six months of electric cars shows an increase of £363, and the receipts per car-mile have increased by ·175d. The mileage run is about the same as last year, but 109,865 additional passengers have been carried. The time for the completion of the tramways authorised by the Corporation Acts of 1899 and 1902 expires on July 22nd, 1908, and for those authorised by the Act of 1904 on July 22nd, 1909. The General Purposes Committee has been asked to recommend application for the extension of time for completion.

TELEGRAPH and TELEPHONE NOTES.

Chile.—A fire in Iquique has interrupted telegraphic communication with that town.

Cuba.—The *Journal of the Telegraph* states that telegraph offices have been opened on Government lines at Agramonte, in Matanzas; Ranchuelo, in Santa Clara, and at El Rincon, in Havana Province, Cuba.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed.. .. .. .. Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Katonou-Lagos	Nov. 2, 1907 ..	Nov. 10
Landlines.		
Puerto-Barrios	Aug. 9, 1902 ..	..

Telephotography.—A demonstration of Prof. Korn's system of transmitting photographs by wire was given at the offices of the *Daily Mirror* on Thursday last week; the inventor delivered a lecture on the subject, and attempts were made to transmit a picture from Paris, but the results were unsatisfactory. Eventually the apparatus was got into working order, and a photograph of the King was transmitted from Paris with success: this, it is claimed, is the first photograph received by telegraph in England, and the first ever sent by cable.

Telegraphists' Strike in the U.S.A.—The strike has absolutely collapsed, and the operators have returned to work.

United States.—Western Union Telegraph Co., 1905-6.—The total capital of the company was £19,474,000, upon which interest and dividends absorbed £1,239,213. The receipts for 1905-6 totalled £6,135,131, and the expenses £4,721,014, leaving a surplus of £1,414,117. The receipts showed an increase over the previous year of £328,404, and the expenses were more by £351,900, so that the net result of the year's working is a decrease of £23,496. The reserve fund amounted to £3,369,745. The company's system was increased by 4,400 km. of cable, 115,188 of wire and 509 new offices during the year, the whole system comprising 2,021,140 km. of wire, of which 566,631 are of copper, this latter figure including 73,093 km. erected during the year. Altogether, £658,596 was spent on new construction, or £427,096 more than the year before. The company handled 4,009,762 more telegrams than during the previous year.

American Telephone and Telegraph Co.—The receipts of this company during 1905-6 were £4,905,219, and the expenses £2,311,032, the net profit being £2,594,187. Of this £2,039,046 was distributed in dividends, and £354,747 was taken to the reserve fund, while £200,393 was carried forward. 1,409,578 new telephone instruments were connected during the year, the total number in use at the end of the year being 7,107,836. The company possessed 3,068,833 stations in 1906, against 2,528,715 in 1905, and increased the wire by 2,717,580 kilometres. The average daily number of conversations dealt with was 16,940,000, or at the rate of 5,455,000,000 conversations per annum, and this works out at an average of 64 telephone calls per inhabitant. £15,873,389 was spent on new construction during 1906, the total construction account being thereby increased to £59,782,851 during the course of seven years. It is stated that this large sum was spent on construction during the year in view of future requirements, and it was also inflated by the high price of labour and material. The policy of the company has always been to provide systems to new places connected, to carry more than the existing traffic, in view of future developments, and owing to the very rapid increase in the use of telephones, others have had to be entirely reconstructed or considerably augmented. The company has also to keep in touch with improvements which occur annually, and is now laying underground cables containing 400 and even 600 circuits.—*Journal Télégraphique.*

Wireless Telegraphy.—A telegram to the *Daily Telegraph* from its Copenhagen correspondent states that successful trials of a new system of wireless telegraphy have been made between Mr. Poulsen's stations at Lyngby and Esbjerg, a distance of about 200 miles. The inventor is Herr Aron von Lepel, and the system, it is said, is cheaper to install and gives much better results than any other method. The apparatus is also much smaller and lighter. The inventor now intends to make experiments between Esbjerg or some other Continental station and England.

Communication is to be established by wireless telegraphy between Mergui in Lower Burma and Victoria Point, with a connection by landline to Maliwun.

Wireless Telephony.—It is reported that the Amalgamated Radio-Telegraph Co., Ltd., has obtained communication by means of wireless telephony over 50 miles across the city of Berlin. This is a world's record.

CONTRACTORS' COLUMN.

Openings for New Business.

ACCRINGTON.—St. James's Church to be re-built (£12,000).

AINSDALE.—Eight houses in Mill Lane. J. Gibson, Mosafield Avenue Ainsdale.

ALNWICK.—New Infirmary in course of erection.

ARBROATH.—Villa residences in Elliot Street. Calder Bros., builders, 82, Keptie Street, Arbroath.

ATHERTON (near Manchester).—New spinning mill to be built by the Ena Spinning Co. (new concern).

AUDENSHAW (Lancs.).—New Council schools. Clayton Bros., builders, Ashton-under-Lyne.

BACUP.—Extensions to Myrtle mill for R. Hopkinson.

BARNSLEY.—E.L. installation at Cockenham Hall. C. H. Charlesworth, Market Hill, Barnsley.

BIRKDALE.—House in Stanley Avenue. J. I. Chambers, Brighton Road, Birkdale.

BIRKENHEAD.—New printing works for Lever Bros., Ltd., Port Sunlight.

BIRMINGHAM.—New Children's Hospital in Ladywood Road. H. K. Beale, deputy chairman of the Committee of Management.

BLACKBURN.—New Hall for St. Thomas's Parish (£2,000).

BOLTON.—Extensions at Johnson, Hodgkinson & Pearson's, Parrot Street Mills.

BOLTON.—Extensions to Riverside Mills in Hacken Lane, Darcy Lever.

Proposed hostel for lady students. Secretary, Bolton Education Committee.

BOURNEMOUTH.—New administration block and out-patients' department at the Royal Boscombe and West Hants Hospital.

Railway Hotel to be re-built. H. C. Cartwright.

Six terrace houses in Stourvale Road. Mr. Butler, builder, Bournemouth.

CANTERBURY.—Residence in South Canterbury Road. Amos & Foad, builders, Whitstable.

CARLISLE.—Extensions to Cumberland Infirmary (£20,000).

CASTLETON (Lancs.).—New spinning mill for the Minto Mill Co. (new concern).

CHEPPING WYCOMBE (Bucks.).—New elementary school for the Borough Council. T. Thurlow, architect, High Wycombe.

CONWAY.—Bungalow residence for Mr. Hayes, Glan, Conway.

(Porthllwyd).—Power station for the Aluminium Corporation.

COVENTRY.—Block of offices in Folly Lane for the Humber Cycle Co., Ltd. T. F. Tickner, architect, High Street, Coventry.

CRESSWELL.—New Wesleyan Manse. F. E. Smith, architect, Queen Street, Worksop.

CROSS HANDS (Carmarthenshire).—New Council School at Cwmgwili. W. V. Morgan, architect to the Education Committee, County Offices, Carmarthen.

DALKEY (Ireland).—Proposed new technical schools for the U.D.C.

DARWEN.—Additions to weaving shed (300 looms) for the Lower Darwen Mill Building Co.

DERBY.—New laundry at Walton Workhouse (£2,000).

DEWSBURY.—Motor garage and repairing works heated and lighted by electricity, for Albert Hunter, 42, Northgate.

DOVER.—Rebuilding business premises for M. Pepper, J.P. Worsfold and Hayward, architects, Market Square, Dover; Geo. Munro, builder, Dover.

DUNBAR.—New church hall at Abbeylands. Parish Church Committee.

DUNDEE.—Additions to factory for F. East & Co., Commercial Street,

Machine shop, &c., for J. Howe & Sons, Frederick Street, Downfield.

Warehouse, office and shops, for T. Bell & Sons, Hawkhill.

Villas for Geekee & Macintosh.

DURHAM.—Residence for attendants at the County Asylum (£2,298). Thos. Boyd, builder, Darlington.

Extensive additions to Council Schools, Chilton (£2,119). G. Gradan & Son, builders, North Road, Durham.

EASTBOURNE.—Additions to All Souls' Parish room. F. G. Cooke, architect, 2, Hyde Gardens, Eastbourne; W. Martin & Sons, builders, Eastbourne.

Nine houses in Sidley Road. R. W. H. Hamblyn, architect, 58, Susan's Road, Eastbourne; J. D. Thompson, builder, Eastbourne.

EDINBURGH.—Electric installation at the Recreation Hall, Bangour, for the Edinburgh Board of Lunacy. H. J. Blanc, architect, 25, Rutland Square, Edinburgh.

EPSOM.—Block of shops in Pound Lane, for Mr. Matthews.

FAILSWORTH.—New public schools at Wrigley Head, with training, cookery and laundry departments, for Cheshire C.C.

FARNWORTH (near Bolton).—New premises for the Manchester and Liverpool District Banking Co. Cunliffe, Pilling & Gask, architects, 37, Mawdsley Street, Bolton.

Extensions to sewage works (£9,000). W. Pollit & Co., Ltd., contractors, Bolton.

FELIXSTOWE.—Residence in Golf Road, for the Hon. A. H. D. Ackland.

GLAMORGANSHIRE.—Additions and alterations to the St. Athan Council School. T. M. Franklen, clerk to the Glamorgan C.C., Council Offices, Westgate Street, Cardiff.

GLASGOW.—Restaurant in Station Road, Scotstoun West. Henderson and Macdonald, 203, Castle Street, Townhead, Glasgow.

GODSTONE (Surrey).—New brick factory for A. P. Ingram.

HADLEIGH.—Public elementary school for Essex C.C. J. H. Nicholas, secretary to the County Education Committee.

HALIFAX.—Alterations to Sowerby Bridge Post Office.

HALTON (Lancs.).—Station buildings for the Midland Railway Co. A. L. Charles, secretary, Derby.

HANLEY.—Mission Hall, &c., for Bethesda Mission Trustees. Wm. Campbell, architect, 103, Victoria Road, Hanley.

HENDON.—Wesleyan schools (£4,000). Rev. J. H. Hocken, chairman of Building Committee.

Addition to St. Vincent's Church. Tasker & Slater, 2, John Street, W.C., architects.

HEREFORD.—New secondary school for boys, for the T.C.

HESSLE, S.O. (Yorks.).—Semi-detached villas for W. Sykes. J. B. Kirton architect.

HITCHIN (Letchworth).—Public building at the Garden City (£3,000). Underwood & Kent, architects, Letchworth.

HULL.—Development of Jalland Estate into Garden City. F. Runton, architect, Hull.

ILMINSTER.—New collar factory for Cook & Co., North Street, Ilminster.

IRLAM (Lancs.).—Proposed public baths. Surveyor, Council offices, Irlam, Lancs.

LARNE (Ireland).—Residence and surgery in Main Street for Dr. W. J. Wilson. J. P. Irvine, architect, 49, Waring Street, Belfast.

LEEDS.—Extensions to officials' accommodation at Armley Gaol for the Prison Commissioners.

LENZIE, N.B.—Proposed alterations and additions to the Council school (£3,000). J. Shanks, architect.

LINGFIELD (Surrey).—Additions to "Nobles" for Sir Lewis Dibden.

LONDON (Brixton).—Alterations to school. Rev. J. Jenkins, vicar of St. John's, Angell Town.

(Southwark).—Converting portion of old police court into Coroner's Court. W. E. Riley, superintendent architect, L.C.C., Spring Gardens, S.W.

(S.E.)—Re-erection of 187-9, Bermondsey Street. E. Crosse & Co., 11, Bermondsey Square, S.E., architects.

Hackney, N.E.—Factory for Alfred Jenkins, 107, Tottenham Road, Hackney, N.E.

Marylebone.—New schools (672 places). Rev. F. S. Webster, 12, Weymouth Street, W. Vicar of All Souls', Langham Place.

(Greenwich).—Alterations to school. Rev. G. F. Cecil de Cartaret, vicar of Christ Church, Greenwich, S.E.

(Piccadilly).—Conversion of Nos. 80 and 81 into Imperial Colonial Club. Mrs. Baker, organising secretary.

(Bond Street).—Rebuilding No. 124. Garrett White & Poland, 16, Hanover Street, W., agents.

(W.C.).—Buildings in Alfred Place. Holloway Bros., 19, Belvedere Road, S.E., builders.

(W.)—Conversion of 1, Berners Street, to offices, showrooms, &c. Davies & Co., 64, Berners Street, W., agents.

(Palmer's Green).—Congregational church. Rev. Ll. H. Parsons, Finsbury Park, N.

(Woolwich).—New premises for Rectory Place Congregational Church. Smith & Sons, Ltd., builders, Carpenters Road, Stratford, E.

(Ealing, W.).—School on "The Lammas" site. C. Jones, engineer and surveyor to the T.C., Ealing.

(Homerton, N.E.).—Additions to Eastern Hospital (£2,300). W. T. Hatch, engineer, Metropolitan Asylums Board, Embankment, E.C.

(Wimbledon).—29 houses. C. Barwell, 2, Ravelstake Road, S.W.

(Wimbledon).—Additions and alterations to Southdown Laundry. J. Garrett & Sons, 17, Balham Hill, S.W., builders.

(Wimbledon).—Conversion of dwelling houses in Haydon's Road into shops. Dawson, Son & Terry, 3-4, Lincoln's Inn Fields, W.C., surveyors.

(Wimbledon).—Additions to premises in the Broadway for Lipton's, Ltd., Bath Street and Old Street, E.C.

(Battersea).—Additons to 74, Thurleigh Road. W. C. Poole, Brighton Railway Approach, Prested Road, Battersea, architect.

(Stamford Hill, N.E.).—Buildings on site of Nos. 134-6. H. C. Webster, 1, Gresham Buildings, Basinghall Street, E.C., surveyor.

(Hammersmith, W.).—Extension of electric power plant at Gwynnes, Ltd., Iron Works. G. G. Bell, electrical engineer, Hammersmith Borough Council.

(Hornsey, N.).—Cottage Hospital (£3,700). Geo. Lethbridge, 7, Draper's Gardens, E.C., architect; Matlock & Parsons, 166, Gray's Inn Road, W.C., builders.

LOUGHREA.—New wing to the Convent of Mercy. W. H. Byrne & Son, architects, 20, Suffolk Street, Dublin.

LYTHAM (Ansdell).—New institute, billiard saloons and library (£4,000).

NEWPORT (Mon.).—New premises for local Co-operative Society in Chepstow Road.

NOTTINGHAM.—New Baptist Sunday Schools, Long Eaton (£2,400). Ernest Hooley, architect.

OLD HILL (Staffs.).—Works for W. Willetts, manufacturer. G. A. Bloomer architect, Old Hill, Cradley.

OSWESTRY.—New Railway Institute.

PAIGNTON.—Science and Art School for the U.D.C. W. G. Couldrey, architect, Palace Avenue, Paignton.

POOLE.—Additions to the new municipal offices. Borough surveyor.

PAISLEY.—Residences for attendants at Hawkhead Asylum, Crookston, for the Govan District Lunacy Board. H. & D. Barclay, architects 245, St. Vincent Street, Glasgow.

PORT GLASGOW.—New elementary, higher grade and supplementary course school for the School Board (£14,200).

RAVENSTHORPE.—E.L. installation at the offices of the U.D.C. Mr. Mountain, engineer to the Council.

REDDITCH.—Proposed new church, parish room and Sunday Schools. Rev. T. E. Healey, Redditch Parish Church.

RETFORD.—New asylum at Rampton.

RHONDDA (Penycraig).—Conversion of part of Penycraig Council schools into cookery and handicraft centres. J. Rees, architect, Hillside Cottage, Pentre, Rhondda.

ROTHERHAM.—Additions to Crown Hotel, including motor garage for Allsop and Sons, Ltd., Sheffield.

New Hippodrome in Henry Street and Nottingham Street, to be lit by electricity. Chadwick & Watson, architects, Leeds.

New elementary school, Wickersley (accommodate 420), for West Riding and Yorks C.C. F. A. Darwen, County Hall, Wakefield.

RUGBY.—New church, St. Peter's. Ford Whitcomb, architect.

RYTON (Co. Durham).—New schools, Greenside, for Durham C.C. (£1,962). N. Ritchie, builder.

ST. ANNES-ON-THE-SEA.—Additions to Oxford House Schools. J. F. Brindle, St. Annes.

Villa residences, stable, coach-house, &c., in Oxford Avenue. Thos. Whiteside, St. Annes.

SALE.—Proposed public baths (£7,000).

Eight new shops in Northenden Road for Messrs. Radcliffe, 37, Moorfields, Liverpool.

SALISBURY.—New Wesleyan Soldiers' Home at Tidworth Barracks (£6,000). Rev. W. Bridie, senior Wesleyan Chaplain, Salisbury Plain.

SANDGATE.—New Military Hospital for the War Office.

SHREWSBURY.—Important additions to Salop Infirmary, including new Nurses' Home (£14,000).

SILCOATES (Yorks).—New college. Oliver & Dodgshun, architects, 18, Park Row, Leeds; Bagnall Bros., builders, Eastmoor, Wakefield.

SNEINTON (Notts.).—Proposed new Congregational Church. Rev. J. H. Taylor, chaplain.

STOCKPORT.—New mill (the third) for the Stockport Ring Spinning Co. at Brinksway. G. Atherton, chairman of the company.

STOCKSBRIDGE.—New hospital for the U.D.C.

SUNDERLAND.—New council schools, Silksworth, for Durham C.C. Brown and Spain, architects, 51, Fawcett Street, Sunderland.

SUTTON (Surrey).—Laboratory for Metropolitan Asylums Board (£6,200). T. W. Aldwinckle & Son, 20, Denham Street, London Bridge, S.E., architects.

SWANSEA VALLEY.—New school, Craigcefnparc. T. M. Franklen, Glamorgan C.C. Offices, Westgate Street, Cardiff.

TONGWYNLAIS (Glam.).—New council school. T. M. Franklen, clerk to the Glamorgan County Council, Council Offices, Westgate Street, Cardiff.

WARRINGTON.—New elementary school, Helsby, for Cheshire C.C. G. F. Ashton, 71, High Street, Runcorn.

WARWICK.—Electric ventilating apparatus at the County Hall, &c., for the C.C.

WELWYN (Herts).—Alterations and additions to Wendover Lodge for Sir A. Scott-Gatty.

Residence at New Welwyn for A. Soper.

WESTHOUGHTON (Lancs.).—New hotel for Sumner's, brewers, Haigh, near Wigan. Mr. Dyson, architect, Horwich, near Bolton.

WEST SULWORTH (Dorset).—Proposed new Parish room (seat 160). Particulars from J. Hazel, Hazeldene, West Sulworth, Dorset.

WEYMOUTH.—New Mission Church in Chickerell Road (£1,800).

WHITBY.—Residence at Ruswarp Bank for Miss H. Falkingbridge. J. Falkingbridge Parker, architect, 18, Coleman Street, London.

WREXHAM.—Theatre and club in Regent Street. J. H. Havelock Sutton, architect, Liverpool.

WRIGHTINGTON (Lancs.).—Proposed new Council school. County architect, Preston.

Fatality.—An inquest was held last week at Grimsby concerning the death of a Great Central Railway crane-driver named Precious, aged 23. It appeared from the Coroner's statement that deceased was engaged hauling empty wagons along the railway lines by means of an electric bollard or capstan which was worked by a bolt. This bolt, pressed by the foot, set the capstan working, and when released, the bolt should stop the machinery. In this case, the Coroner believed the bolt stuck, and did not do its work. Deceased got entangled in the steel wire hauling rope, and being whirled round and round, his head was battered on a wagon wheel only 3 ft. away.

Hugh B. Bingham, foreman in charge of the electrical department at Grimsby for the G.C.R., said the capstan, which deceased was working, was under his charge. The releasing of the bolt or pedal should switch the current off, the pedal being actuated by two springs. No complaint had been made to him that the pedal did not work properly, but he had inspected it and found it in proper order. He had since heard that the pedal did not act, but if this was so, it was deceased's duty to make a report of the fact. Witness had since examined the pedal, and he found that some sand had worked its way in the opening; this would be likely to make it stick. It was possible, if the man fell sideways, that his foot would cause the pedal to cant and stick under the edge of the plate. A verdict of "Accidental Death" was returned.

ELECTRICAL DEVELOPMENTS AT THE SUNDERLAND FORGE ENGINEERING CO.'S WORKS.

The town of Sunderland has long been identified with the strenuous commercial rivalry of the Wear Shipbuilding Yards and their near neighbours on the Tyne, with the result that Sunderland has forged ahead under this influence, and not only shipbuilding but many allied and subsidiary industries have developed to a large extent.

Closely connected with the Wear industries for the past 20 years has been the Sunderland Forge and Engineering Co., which, in addition to its well-known specialities in general forging, is to the fore as the maker of certain electrical specialities of considerable merit.

Fig. 1.—The Armature Winding Shop.

An important section of the work consists of ship lighting installations, of which over 300 have been carried out by the company, which, it may be remarked, is in an exceptional position as regards this particular work, owing to the fact that it manufactures both engines and dynamos, in addition to carrying out the installation and wiring with its own staff.

The firm also specialises in electric winches, hoists and cranes for shipyard use; and in direct-current and polyphase motor work generally. The company's works are situated at Pallion, on the outskirts of Sunderland, and adjoin the North-Eastern Railway; that section devoted

Fig. 2.—View of the Light Machine and Erecting Shop.

The company has, of course, had some 12 years' experience in electrical work, and has therefore had ample time not only to develop its specialities, but also to perfect its business organisation and works equipment.

to electrical and mechanical engineering comprises three principal and several lesser shops, forming a **V**-shaped block of buildings, with the offices close at hand.

The heavy machine shop, shown in fig. 5, p. 812, to which we

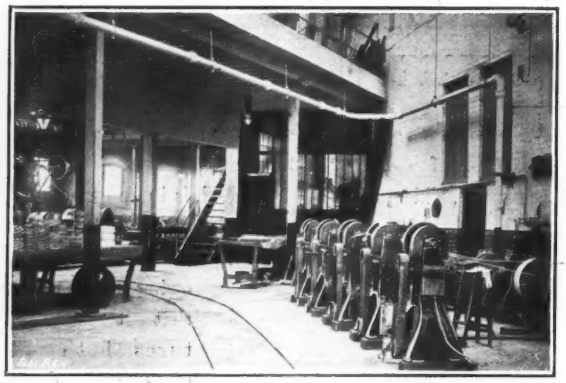


Fig. 3.—Corner of the Armature Shop, showing Coil Winders.

may first refer, contains an equipment of electrically-driven machine tools, in which the heavier operations of boring, planing and turning are carried out.

This shop is spanned by a 20-ton 4-motor electric traveller, constructed throughout by the Company, and arranged to pass through the end of the building on a gantry, which extends over the adjacent railway, thus facilitating the handling of heavy material and plant.

Among the machinery, we noticed a double-ended lathe for 40-in. centres, with an 80-ft. bed, each headstock being operated by a 35-H.P. motor; a 6-ft. vertical boring mill for machining the magnet rings and carcasses of generators, &c., driven by a 10-H.P. motor; a three-headed horizontal boring machine adapted for dealing with winch frames and similar work; and a heavy shaping machine of special type, driven by a 16-H.P. motor.

Practically all the tools, which in addition to the above included smaller lathes, slotting, planing and drilling machines, &c., are driven by individual direct-current motors of the company's own make.

Adjoining this shop, and parallel to it, is a new bay, shown in fig. 1, devoted entirely to electrical work, to wit, armature winding and electrical testing; and here a good idea of the generator and motor work carried out by the firm—ranging in size from a ½-H.P. motor to a 300-KW. generator, and including both direct and alternating-current machinery—can be gathered.

The tool equipment includes sundry machines specially adapted for the work here dealt with; among these may be mentioned six coil-winding machines, built by the company, and shown in fig. 3, each operated by a small shunt-wound motor, the speed of which is regulated by the knee of the operator pressing on the regulator handle. In these machines, all the armature and field coils are formed prior to bending to shape for insertion in the armature slots.

The armature binding is carried out in a special machine, driven by a 2-H P. motor, enclosed in the headstock. This machine carries three different sizes of binding wire, which pass to the armature through an adjustable feed; it is operated through a clutch, and gives four spindle speeds. Adjacent to it are a 14-in. lathe for commutator finishing and a wire-stretching machine (driven by a ½-H.P. motor).

Fig. 4.—View in the Brass-Finishing Department.

The latter machine is a time saver; it can be adjusted to draw out rapidly and cut off to any required length the copper wire used in armature windings, thus avoiding the somewhat lengthy process of hand straightening and cutting. The impregnating and vacuum drying plant, installed at one side of this shop, includes a useful modification of the standard apparatus. This consists of a small motor-driven vacuum pump, a receiver, steam drier, and varnish tank; for impregnating purposes, a vacuum is created

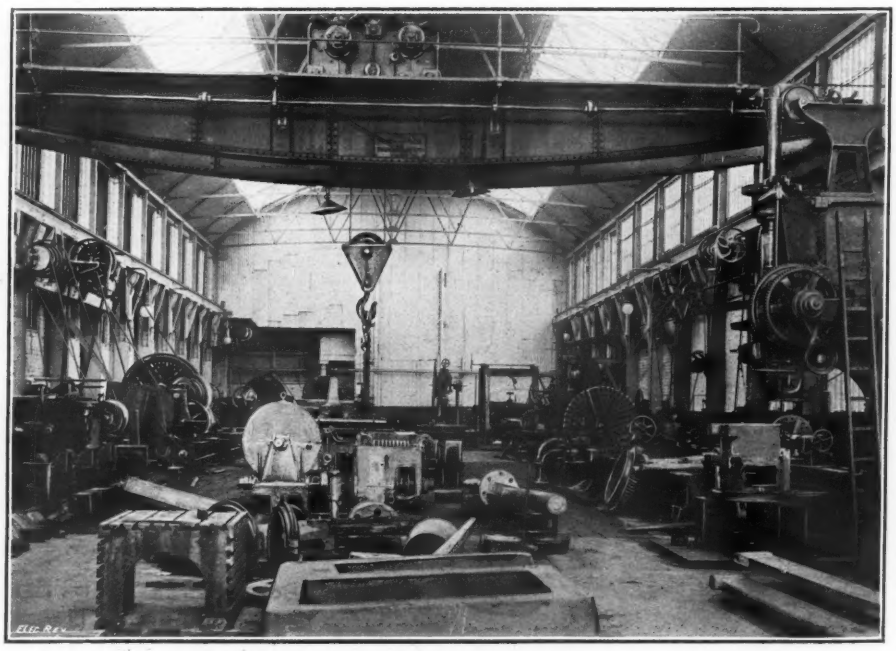


Fig. 5.—The Heavy Machine Shop.

in the drying chamber, and the varnish is drawn in from the adjacent tank, and when this operation is completed the varnish is returned to the original receptacle by the simple expedient of creating a vacuum therein. The arrangement keeps the varnish in good condition, comparatively free from air and grit. The shop, one end of which contains the test bed, is spanned by a 4-motor electric crane, having two lifts of 15 and 2½ tons, and built by the company.

The soldering operations in the armature shop are facilitated by the carefully-devised gas supply arrangements, some 32 connections being provided at regular intervals in the concrete floor.

An interesting innovation in armature insulation testing has been devised in this department, sound indications being employed through the medium of a telephone receiver.

A small motor-generator in the testing department furnishes a supply of alternating current to test leads on the wall at one side of the winding space—the pressure between these being varied as required by means of a liquid resistance. Test leads can be plugged into this circuit at intervals; the extremeties of the leads being brass-tipped for making contact with commutator segments. The tester, listening to a telephone receiver coupled up to a pair of contacts arranged for two adjacent commutator segments, hears the familiar buzz of the "engaged" telephone if all is right, a faint sound indicating defective insulation between the adjacent segments under test.

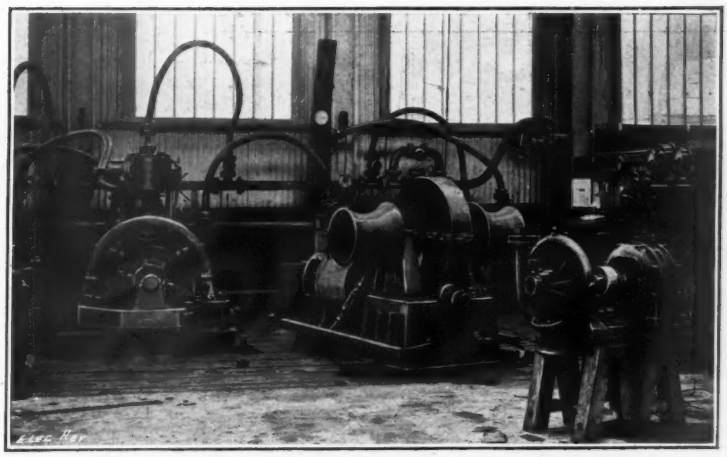


Fig. 6.—A Corner of the Test Bed.

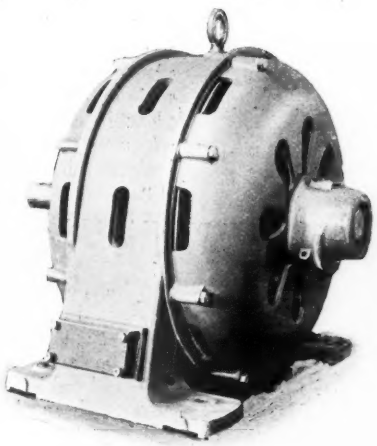


Fig. 7.—Standard Squirrel-cage Motor.

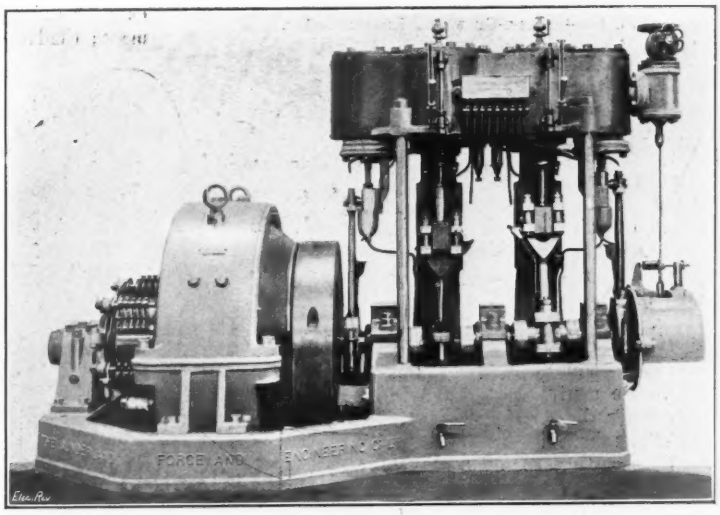


Fig. 8.—Standard "Pallion" 35-kw. Ship-Lighting Set.

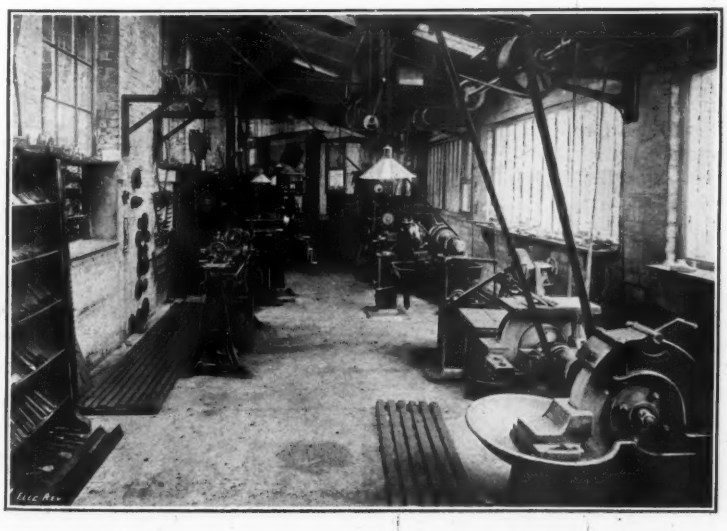


Fig. 9.—View in the Tool Room.

This arrangement allows of rapid testing and at the same time dispenses with instruments which, from the frequent moving to which they are subject, are liable to error and damage.

The company uses solid-forged shafts and couplings for all its motor and generator work, the armature spider and commutator sleeve, in one casting, being pressed on to the shaft. Pure mica insulation is used in building up the commutators, and the latter are mounted on micanite cones; the armature slots are of the semi-closed type, the windings being secured by hornbeam wedges—from which constructive details, and from figs. 7 and 12, of a standard squirrel-cage motor and 250-kw. open-type generator respectively, it will be gathered that modern practice prevails in these works.

The other arm of the buildings constitutes a general

machine shop, provided with a gallery for the lighter tools, &c. This shop, shown in fig. 2, contains a very complete equipment of tools, those in the lower part being—with the exception of a few large machines—driven by a 50-H.P. motor.

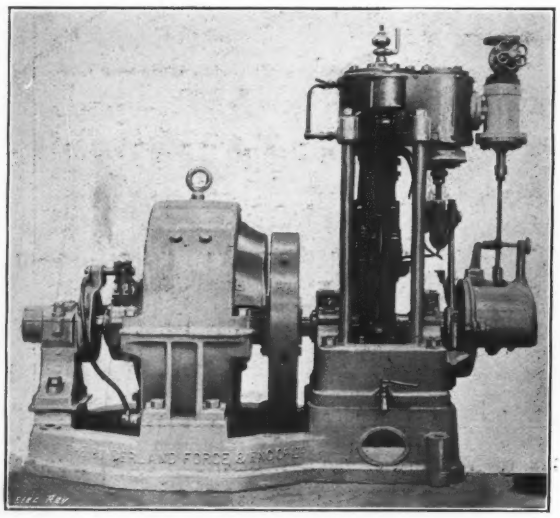


FIG. 10.—SINGLE-CYLINDER LIGHTING SET.

It is hardly necessary to refer in detail to this portion of the equipment, but as showing the advanced methods obtaining, we may mention that micrometer gauges—$\frac{1}{2}$ in. to 6 in.—are used throughout for diametrical dimensions, as also limit gauges for bores in all cases. Further, instructional cards dealing with these devices, which contain also particulars of decimal equivalents, &c., are hung round the shop.

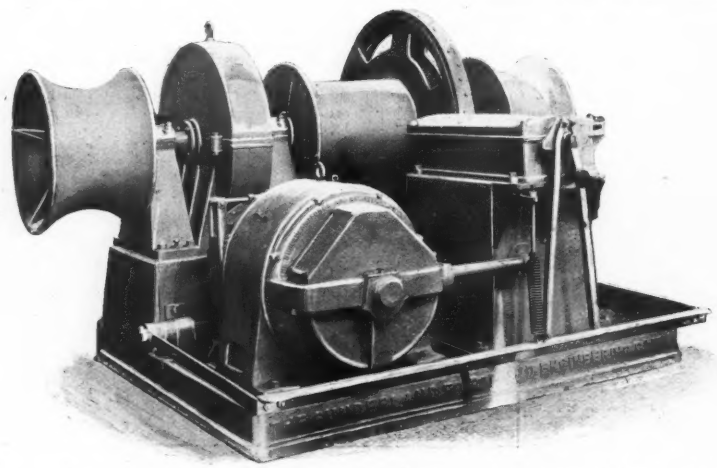


FIG. 11.—THREE-TON BAGGAGE WINCH, AS INSTALLED IN THE WHITE STAR SHIP "ADRIATIC."

Herbert turret lathes are used for the small repetition work, and a grinding lathe deals with all the armature, motor, and small shafts turned out. A hydraulic press equipment is installed for pressing the armatures on the shafts; the same pumps—motor driven—are utilised for testing all steam cylinders to double working pressure.

For the handling of material, a 10-ton three-motor crane and several jib cranes are provided in the main shop. The gallery, of which fig. 4 illustrates a portion, is used for numerous lighter operations, including brass finishing, commutator assembling, the fitting-up of crane and winch controllers, and pressing brass clips, &c., for installation work, and a small electro-depositing plant is installed for copper and nickel-plating the small fittings turned out by the company. The tool equipment, including drills, turret lathes, &c., is driven by a 15-H.P. motor, and two small electrically-driven jib cranes are provided.

One end of the shop opens on to a store containing drawings and tracings for shop use; above it is the main drawing office. We may here say that, in addition to ordinary routine work, this office designs all the tools, jigs, &c., used in the works. The other extremity of the shop also opens on to stores, the upper floors being devoted to electrical accessories, fittings, and small engine parts. A noticeable feature of all the stores, cupboards and lockers is the use of expanded metal instead of solid panels in the doors, an arrangement which obviously saves considerable time and labour on the part of those in charge.

The tool shop, fig. 9, occupies a position between the general machine and armature winding shops, having access from both; it is, needless to say, a very important adjunct, and is recognised as such by the company.

Nothing but high-speed steel tools and drills, air hardened, is employed in the works; and all the tools in use are exchanged against checks, four of which are issued to each man. The exchanged checks are further hung up beside a description of the tool taken out, and as the owner of a check is known, any tool can be immediately traced. The machinery installed in the tool room includes an automatic band-saw sharpener, a saw-brazing machine, and a setting machine—band saws being used largely for cold-metal sawing in the works—small lathes, shaping and drilling machines, Cincinnati and Universal grinding machines, and a special twist-drill grinder.

A gas-heated annealing and case-hardening stove also finds a place, as well as a 10-H.P. motor for driving the machinery.

Duplicate tools are stored here with a view to avoiding loss of time, and a special rack is devoted to jigs, which are used wherever possible.

Turning from the excellent tool-making equipment, a short reference may be made to the smith's shop, where Keith and Blackman electrical fans are fitted to the hearths, and used for air-hardening the tools. A Pilkington steam hammer and a Cochrane boiler also form part of the equipment; the latter serves for multifarious purposes, including the test running of the ship lighting plants, when the main steam raising plant — consisting of two marine boilers, each of 500 H.P., with a working pressure of 200 lb. per sq. in.—is shut down.

The company makes its own patterns; the pattern shop and store is an isolated building, with a full equipment of woodworking machinery.

Finally, we may refer to the test room, shown in fig. 6, through which the engines, generators, winches, and other plant pass for final testing before being sent away.

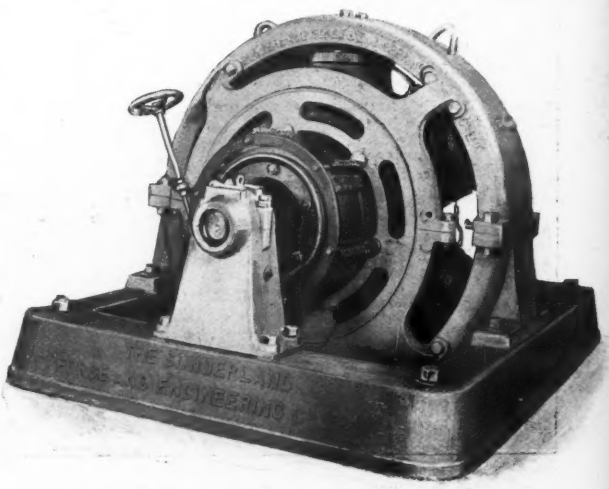


FIG. 12.—STANDARD 250-KW. OPEN-TYPE GENERATOR.

Switchgear occupies one side of this room, and steam and exhaust piping another—flexible steam and exhaust pipe connections being made to the engines under test.

The firm pins its faith on low rather than on high-speed engines, as being less costly to operate, and at the time of our visit, among other plant, a standard "Pallion" 40-KW. steam generator, running at 300 R.P.M., was under test. The engine, of the compound open type, was fitted with piston valves, which are adopted in all cases, and with throttle governing by a shaft governor which is guaranteed to control the speed within 2 per cent.; it was one of 13 supplied to one firm of ship-owners. The generator, of the compound-wound six-pole type, wound for 100 volts, was fitted with the company's own brushes, having a parallel action, and was designed for fixed brush position at all loads.

As a contrast, the smallest combined set, built by the firm for electric lighting on trawlers, &c., was also under test; views of these ship-lighting plants are shown in figs. 8 and 10.

A 3-ton shipyard winch, one of 16 on order for a large shipyard, was approaching completion. This winch represents the most recent development in a line in which the company has specialised for several years. The motor and controller are combined in one casting, and the motor operates the winch through worm gear running in an oil bath. A magnetic brake is fitted, also a foot brake which automatically rotates the controller to the off position before applying the brake, and thus safeguards the motor. The resistances are enclosed in the motor casing, and the whole of the apparatus is watertight. In fig. 11 we illustrate a baggage winch, embodying many of the features described above, which is capable of lifting 3 tons at a speed of 100 ft. per minute, and lighter loads at higher speeds. Two of these winches are installed on the White Star liner *Adriatic*. In connection with winch work, a testing well has been put down, giving a lift of 40 ft., and all winches are tested on full load.

In connection with the test room, an 80-H.P. motor-generator is installed for giving one to six phases at varying periodicity and pressure through transformers.

All the shops are lighted by arc lamps and heated by hot water, and in other directions every care is exercised in the interests of the employés.

A card index system of one sort or another usually finds a place in every up-to-date works. In this case the company has adapted to its needs a system which apparently gives full control of the costing, shop-work and stores, and, in fact, plays an extremely important part in the organisation of the business.

Some 450 men are employed in the workshops and outside on ship-lighting and shipyard installations, the firm having extended its operations to all the principal shipbuilding centres in the United Kingdom. In connection with the installation work, a special outside store is provided, large stocks of cable, conduit, lamps, glassware, fittings and switches, being held in readiness for this work.

In conclusion, our thanks are due to the company for affording us this opportunity of recording the impressions of a most interesting and instructive visit.

CONTRACTS OPEN and CLOSED.

OPEN.

Almeria.—November 28th. Various materials connected with the 350 metres extension of the Port of Almeria, including six electric cranes and 108 iron cases for same, &c. The requirements are divided into four distinct lots, the total to be deposited on which amounts to about £836. Local representation is necessary. A copy of the specification (in Spanish) for the supply of the electric cranes has been received from the British Vice-Consul at Almeria (Mr. J. Murison). This, together with the *Gaceta de Madrid*, which contains further particulars of the materials required, may be seen by British firms at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C. —*Board of Trade Journal.*

Australia.—SOUTH AUSTRALIA. January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones. Commonwealth Office, 72, Victoria Street, S.W.

MELBOURNE.—80 A.C. flame arc lamps for the City Council. See "Official Notices" November 1st.

SYDNEY, N.S.W.—Meters for the Municipal Council. See "Official Notices" November 1st.

Austria.—A new turbine and dynamo are shortly to be installed at the municipal central electric lighting station at Schlanders, in the Austrian Tyrol. Tenders are being at present invited.

Brussels.—December 31st. The Commandant du Génee requires tenders for the electric lighting of the Military School. Specifications, 1s. 8d., from 40, Rue de Reutiers. A deposit of £240 is required.

Buenos Ayres.—The Public Works Department requires tenders for laying and equipping two new telegraph lines.

Chatham.—November 21st. The B.C. requires tenders for the annual supply of incandescent electric lamps.

East Stonehouse (Devon).—The U.D.C. invites tenders for the installation of fittings, wiring, lamps and accessories in the Town Hall Buildings. C. H. Trounce, surveyor, Town Hall.

Liverpool.—November 21st. The Cheshire Lines Committee requires tenders for annual supplies, including telegraph and permanent way materials. Particulars from Mr. Glegge Thomas, secretary, Central Station, Liverpool.

London.—November 27th. Alterations to fire alarm and telephone systems for the Gore Farm Fever Hospital for the Metropolitan Asylums Board. See "Official Notices" to-day.

Manilla.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Montreal.—December 16th. Tenders for the supply of gas and electricity in Montreal are now being invited by the Fire and Light Committee. They have to be sent to the office of the City Clerk, City Hall. The full details appear in a large advertisement in the *Times* for November 11th. The electricity section is given thus: (*a*) The public lighting, by electricity, of the streets, parks, squares, and other real estate belonging to, or under the control of, the city, from the expiry of the contracts now existing. (*b*) The supply of electrical energy for lighting, heating, and industrial purposes for the citizens.

New Zealand.—December 11th. The Napier T.C. requires tenders for electric tramways, lighting and power supply. Frank N. Bower, Town Clerk.

Peterborough.—November 21st. Feeder cables for the Electricity Committee. See "Official Notices" November 8th.

Portsmouth.—November 19th. 150 tons steel girder rails and 100 pairs steel fishplates for the Corporation Tramways Committee. See "Official Notices" to-day.

Rawtenstall.—November 29th. Lighting and tramway cables, conduits, trenching, &c., for the Corporation. See "Official Notices" to-day.

Southampton.—November 30th. Boilers, generator, and cables, for the Corporation. See "Official Notices" to-day.

Trent.—November 23rd. Mains and services, balancer and booster, and switching apparatus, for the Electricity Committee. See "Official Notices" November 8th.

CLOSED.

Australia.—MELBOURNE.—Postmaster-General of Victoria: J. A. Newton & Co.—9,000 copper binders for copper wire, 300 lb. per mile, £65 5s.; 9,000 copper tapes for copper wire, 300 lb. per mile, £65 5s.

PERTH.—London tender, per Agent-General.—copper plates, £103 7s., £100 18s. 3d., £94 19s. per ton. A. W. Dobbie & Co.—7,000 zincs for Fuller's cells, £149 7s. 6d. Saunders & Stuart.—25 cast-steel tappets, £2 10s. each; 25 ditto, £1 17s. 6d. each. London tender, per Agent-General.—20 tons line wire to British standard, £16 17s. 6d. per ton; 84 lb. joint wire, £23 8s. per ton.

Bradford.—The Bradford Electrical Engineering Co., Ltd., have been appointed electrical engineers to the Bradford Board of Guardians. They have also secured the following contracts:—

Electric light and power installation (three-phase) for Messrs. Cook, Sons and Co., Spen Valley.
Electric light installation for *Bradford Daily Argus* works and offices, also arc lighting.
Extension of cables and mains at Union Workhouse, Bradford.

Croydon.—The T.C. has accepted the tender of Messrs. Edward Lee Bas & Co. (£945), and Mr. A. Wiseman (£130 13s. 5d.) for the supply of overhead wires and fittings for the tramways.

Devonport Dockyard Contract.—Referring to the note in our last week's issue concerning the electrification of Devonport Dockyard, the British Westinghouse Electric and Manufacturing Co., Ltd., inform us that they have contracted with the Admiralty for over 300 motors with special control gear. These motors have been applied by the Westinghouse Co. to the driving of large machine tools, cranes and other workshop machinery at Devonport Dockyard. The whole of the apparatus has been constructed at the Westinghouse Works, Trafford Park, Manchester, and not in American competition with British interests, as erroneously reported by the *Daily Mail's* correspondent's cable to which we referred.

Dundee.—The T.C. has confirmed the Electricity Committee's minute, and has unanimously accepted the tenders notified as accepted in our last issue. An order for stock cables has been given to the British Insulated & Helsby Cables, Ltd.

Heckmondwike.—The U.D.C. has accepted the tender of Messrs. Babcock & Wilcox for the supply of a boiler.

Leeds.—The T.C. has accepted the tender of Messrs. Willans & Robinson, Ltd., for the supply of a steam turbine, alternator, exciter and condensing plant, at £13,705.

London.—HAMPSTEAD.—The B.C. has accepted the following tenders for annual supplies of cable:—

W. T. Glover & Co., Ltd.—High-tension and three-core cable.
W. T. Henley's Telegraph Works Co., Ltd.—House service cable.

L.C.C.—The Fire Brigade Committee of the L.C.C. has received the undernoted tenders for the wiring and fittings for the Charlton fire station:—

Spagnoletti, Ltd.	(recommended)	£109 15
Cannon & Sons		122 7
Fryer & Co.		147 0
Nursey & Marr		147 0
Smeeton & Page		166 5

The Highways Committee of the L.C.C. proposes to accept the offer of the Standard Engineering Co. to supply two electric ventilating fans for the temporary car repair depôt at New Cross, for the sum of £75.

Warrington.—The T.C. has accepted the tender of the St. Helens Cable Co., Ltd., for a year's supply of cables.

Wimbledon.—The E.L. Committee has decided to purchase 10,000 "Flame" arc lamp carbons from the Sloan Electrical Co., Ltd., at £7 19s. 6d. per 1,000.

Wrexham.—The T.C. has accepted the tender of the Lancashire Dynamo and Motor Co., Ltd., for the supply of a 60-kw. steam dynamo, at £550.

Whitby.—The U.D.C. has accepted the tender of Messrs. W. T. Glover & Co. for the supply of cable for the new bridge, which is to be operated by electricity, at £69.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 15th).—At 8 p.m. At the Institution House, Storey's Gate, St. James's Park. Institution of Mechanical Engineers. Mr. E. J. Way (Johannesburg), paper on "Labour-Saving Appliances at the Mines of the New Kleinfontein Co., Transvaal."

Saturday, November 16th.—At 3.30 p.m. Institution of Electrical Engineers (Students). Visit to the Central Telephone Exchange (G.P.O.), Carter Lane, E.C.

At 7.30 p.m. Meeting of the Glasgow Technical College Scientific Society, at the College. Paper on "Sub-station Equipment," by Mr. J. Prentice.

Monday, November 18th.—At 8 p.m. At Armstrong College, Newcastle-on-Tyne. Institution of Electrical Engineers (Newcastle Section). Presidential address by Mr. J. Pigg.

Tuesday, November 19th.—Liverpool and District Electric Association, Common Hall, Liverpool. Renewed discussion on "The Commutation of Direct-Current Machines."

Wednesday, November 20th.—At 7.30 p.m. At the University, Edgbaston. First meeting of the session. Institution of Electrical Engineers (Birmingham Local Section). Inaugural address by Prof. G. Kapp, chairman.

At 8 p.m. Society of Arts, John Street, Adelphi, W.C. First ordinary meeting. Inaugural address by Sir Steuart Colvin Bayley, chairman.

At 7.30 p.m. At 92, Victoria Street, S.W. Institution of Electrical Engineers, Students' Section. Lecture by Mr. Robert Hammond on "Electrical Legislation."

Friday, November 22nd.—At 5 p.m. At the Royal College of Science. Meeting of the Physical Society.

Saturday, November 23rd.—At 10 a.m. Junior Institution of Engineers. Visit to the Royal Arsenal, Woolwich.

Monday, November 25th.—At 7.15 p.m. At the Department of Applied Science, the University, St. George's Square, Sheffield. Mr. W. H. F. Murdoch, paper on "Magnetic Testing of Iron."

NOTES.

Notes on Business Management.—Can the works or business manager make himself too essential? The New York *Electrical Record* quotes an American writer, who expresses himself very decidedly in the affirmative. The idea is one that might well be weighed by ELECTRICAL REVIEW readers who are responsible for the control of electrical manufacturing or trading undertakings. The always-present manager may stand in the way of the helpful progressive initiative and the youthful spirit of enterprise among those who serve directly under him, and in that way the development of a business may be far slower or smaller than it might otherwise be. While making due allowance for occasional blunders, it should generally be regarded as a good thing for reliable and trustworthy men to be left to their own resources—within reasonable limits. It is necessary and good for every manager to get outside the walls of his own buildings at times. These callings away bring him into touch with other men and other ideas and methods, freshening his view of things and preventing him from getting into a rut. The manager who can be "out" in person, but has so trained his subordinates that his presence still pervades the works' office, hardly need fear that in his absence the interests of the business will be neglected or that discipline will suffer. It is quite possible for a manager by his too-constant presence to rob his sub-managers and assistants of the desire to put their best into things because there is the responsible chief to look to, and they have not any pressing necessity or opportunity to reveal what is in them. The foregoing remarks must be taken as applying chiefly to comparatively small undertakings; with very large works the mistake is less likely to occur. The manager of such a factory will be, to a very large extent, a manager of sub-managers and a general dictator of policy. But in some respects they would apply to the sub-manager whose duties cover a department which is quite as large as some of the smaller works we have in mind. We append below the comments of the American writer, whose notes have led us to write the above:—

"*Don't Be Too Necessary.*—A man's value to a business is not always in proportion to the influence of his personal presence. Sometimes the ability to leave a business for a time and have it go on as smoothly as ever is the best test of a man's control over it.

"A factory manager was taking an extra hour away from his work one noon, and remarked to a friend, with apparent pride:—

"'I must be going back, or everything will be at a standstill. I can't leave the shop for two hours without causing a difference in the work. It doesn't take long for things to be going at loose ends unless I am right there to watch them.'

"This man, trying indirectly to raise himself in his friend's estimation, was really confessing his own weakness, and laying bare his secret misconception of the functions of a manager. The humour of the situation is apparent when we remember that many of the owners and managers of vast business establishments are able to be absent from their offices for weeks and even months at a time.

"The good organiser, unless he is limited to very poor material, is usually the man who makes his own personal presence less and less of a necessity to the harmonious working of the system."

Lot's Road and Smoke Nuisance.—The Chelsea Medical Officer of Health, in a report issued on Monday, deals with the comments of the Westminster Police Court magistrate in regard to the recent prosecution of the Underground Electric Railways Co. for causing an alleged smoke nuisance at their generating station in Lot's Road, Chelsea. The summonses were dismissed, 300 guineas costs being granted to the defendants. With reference to the magistrate's remark upon the absence of specially skilled engineering evidence on the construction and use of electrical generating power houses of a similar character to the Lot's Road station, the Medical Officer points out that at present there are very few large power generating stations in this country, and the number of engineers who have practical experience in their construction, control and management is extremely limited. An attempt to obtain the assistance of the engineering staff of the L.C.C. was unsuccessful, the L.C.C. engineer being of opinion that expert engineering evidence would not be required. The magistrate had suggested that the prosecution of a company engaged in promoting the public benefit, by clearing the underground railways of smoke and steam, was an ungenerous act on the part of the Borough Council. In regard to this, however, the medical officer states that for nearly 15 months whilst the works were in an experimental stage, no notice was taken of the smoke emitted from the chimneys of the works, although complaints were frequent. Mr. Towle, the resident engineer at Lot's Road, had expressed his sense of the generosity of the Borough Council in allowing the company so much latitude in the early stages, and had said that when the station was in full working order, there would be little reason to complain of any smoke emitted from the chimneys. That desired result was not attained, and the B.C. twice took proceedings without success. They would not have instituted proceedings a third time, but for a threat by the L.C.C. to treat them as a defaulting authority if they did not. A question was raised during the hearing as to whether the smoke emitted was black or not, and the defence called an engineering expert, Mr. Swinburne, who expressed the opinion that the term "black" could only be applied to smoke from which 90 per cent. or more of the light had been cut off. The Medical Officer remarked that in future the Council would have to call evidence on these lines, and have photographs taken of the smoke, as the defendants in this

case had done. The Public Heath Committee recommends that as the prosecution was instituted at the urgent request of the Public Control Committee of the L.C.C., and as the smoke question is one affecting the whole metropolitan area, the L.C.C. be asked to furnish a substantial contribution to the costs incurred in the recent proceedings.

College and Apprentice Training.—In a discussion on this subject before the American Society of Mechanical Engineers, Mr. G. M. Basford said: Speaking from the standpoint of one who has worried about this question in an organisation of 21,000 men, it seems vitally necessary to point out an error which is now serious and will certainly become more serious. It is well to provide for college men in industrial organisations, but the experience of the past 30 years has proved and present experience is proving every day that the vital need lies not in college men but in the shop workmen upon whom we depend for output and for those things which may be summed up in one word—"results." It is well to provide for the college men; it is, however, a mistake more serious than most of us can now realise to provide for them unless we have previously put our shop recruiting system for the workmen—the men who do our work—upon a proper basis. I cannot find the words to say, as it ought to be said, that college graduate apprenticeship is wrong from every standpoint unless based upon and preceded by a proper recruiting system, and what we generally understand by the term "regular apprenticeship." If we have a proper regular apprenticeship system we have a moral right to deal with college graduate apprenticeship. If we have not such a system, we have no such right and we are making an error for which we shall in time pay dearly. It is easy to realise that this is not a popular sentiment to express, but a warning is evidently needed, lest we build our pyramid upon its apex. We stand in need of captains and a few subordinate officers, but we stand in greater need of an intelligent rank and file. In developing the first class let us not kill the second. If we had a good organisation as to the rank and file, the captains and subordinate officers would not constitute a problem. It is from the rank and file that we always have and always will develop leaders. We shall suffer in the long run for any policy which tends in any way to discourage ambition in the large class of men upon whom we must rely. The best we can do for an industrial organisation and for everyone who enters it is to put recruits upon an actual rather than an artificial footing, allowing everyone to make his place in the organisation in competition with everybody else. The company already alluded to has for two years made a practice of taking college men in as workmen at a living wage with no promises and no special privileges. The plan is working well and promises well.

Mr. W. B. Russell said: Why is the technical graduate so useless? Because he has spent four of the most receptive years of his life out of touch with actual shop and labour conditions, and out of touch with practical commercial life and ideas of cost, economy and output. The two most serious needs in our present industrial condition are:—(*a*) The need for skilled mechanics; (*b*) the need for industrial leaders who can understand men; can organise their efforts and can cut out lost motion to the mutual advantage of both employer and employé. The first need can be met by a proper system of regular apprenticeship. The second need can be met by the technical school, but in order to do this, two more or less radical changes must be instituted. The special apprenticeship, or, better still, regular apprenticeship, and the technical course should be carried on at the same time instead of one following the other, and the present courses in mechanical engineering should be simplified and thereby strengthened and made more effective. In regard to the first requisite, many colleges are already requiring shop work during vacations. The University of Cincinnati is trying with success the method of alternate weeks in school and shop. Any method will be satisfactory that gives the boy an intimate knowledge of shop and labour conditions during the receptive period of his life. It is impossible for technical courses to cover all the varied applications of science, and the attempt to do this is demoralising. Manufacturers do not want men who know it all, but men who in this "industrial complexity" can get back to fundamentals; men who can think and who can tackle new problems. This type of man is better produced by a thorough training in a few subjects than by an increase in the number and grade of subjects taught.

An Architect's Electrical Specification. — The *Electrical Record*, of New York, publishes the following notes from an American architect's specification for an electric wiring job. Our contemporary remarks that the extracts are eloquent of the need of electrical education for the average architect, or of the addition to his staff of someone who knows about such things. "With a specification of this kind to bid upon, it would not be remarkable if the architect received a somewhat bewildering variety of figures." The specification was received from a prominent firm of electrical contractors, who describe it as the most interesting curiosity they have ever run across, though they have had hundreds of specimens "worthy of attention" during the last few years. The architect stated that the specification was intended to cover "a knob and tube" job. The specification reads as follows:—

"*Electrical Work.*—The contractor shall pay all charges for the inspection of the work and upon its completion secure a satisfactory certificate of its acceptance at his own expense, the very best service and secure likewise at his own expense for a period of two years, the efficiency of the system and shall submit both to the architect.

"*System.*—The building shall be thoroughly equipped from the service of supply to each outlet, with best insulated condition, put up in such manner as to provide continuous insulating channels for all wires and the tubes to be so well connected as to exclude water and gas.

"All wiring shall be done in a thorough and workmanlike manner and to be well insulated and wrapped at each and every joint. Place wires as shown on plans and leave enough wire so as to be able to connect with fixtures when necessary. The owners will provide all lights, and the electrician set same in place.

"Place all necessary shut-offs and cut-offs on each fixture and place a switch at head of stairway to cut off hall lights on first floor. Also place a switch at bottom of stairway to shut off or turn off lights at head of stairway."

Electrical Smelting of Titaniferous Iron Ores.—A paper was read by M. G. Gin, of Paris, before the last meeting of the American Electro-chemical Society, in which the author described certain experiments he had carried out, which had led him to the conclusion that titaniferous iron ores could be profitably smelted in an electric furnace in localities rich in such materials, provided that a copious supply of cheap water power was available. His first experiments were made upon a Norwegian ore containing Fe_3O_4, 55·73 per cent.; Fe_2O_3, 3·16; $TiFeO_3$, 30·90 (Fe = 53·76; TiO_2 = 16·40); SiO_2, 0·56; Al_2O_3, 3·61; other constituents, 3·61 per cent. The charge put in the furnace consisted of 100 parts by weight of ore, 15 of limestone and 25 of coke. In four hours, when 286 KW.-hours of electricity had been impressed upon 274 kilogrammes of the mixture, 102 kg. of metal were recovered, which contained Fe, 94·60; C, 3·10; Si, 0·86; Ti, 0·10; P, 0·06; other constituents, 1·28 per cent. The consumption of energy was 2,850 KW.-hours per metric ton of iron, but on a large scale it would probably not have exceeded 2,280 KW.-hours. The slag contained TiO_2, 32·50 per cent.; SiO_2, 20·80; Al_2O_3, 4·10; FeO, 8·10; CaO, 32·70; other constituents, 1·80 per cent.

A second set of experiments was performed upon a sandy concentrate raised in Java, which was smelted with limestone and coal in a resistance furnace, using a direct current of about 500 amperes at 60 to 65 volts. The charge melted easily; and in one hour's time the temperature, measured by a Wanner pyrometer, was over 1,900° C. The ore contained FeO, 28·50 per cent.; Fe_2O_3, 49·95; MnO, 0·98; CaO, 0·37; MgO, 2·35; TiO_2, 16·00; SiO_2, 1·60; other substances, 0·25 per cent. The metal contained Fe, 94·94 per cent.; Mn, 1·52; C, 3·05; Si, 0·37; P, 0·11; S, 0·01 per cent.; and only a trace of titanium. The slag was very fluid, and contained SiO_2, 8·90 per cent.; TiO_2, 38·72; Al_2O_3, 5·18; FeO, 10·03; CaO, 34·80; other substances, 2·37 per cent. It will be seen that the crude metal contained a very small quantity of sulphur; whilst the greater part of the phosphorus was derived from the coal employed.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE SECTION).—This Section holds its first general meeting of the session on Monday next, November 18th, when Mr. James Pigg, the chairman, will deliver his inaugural address. The annual dinner takes place on Wednesday, November 27th.

INSTITUTION OF ELECTRICAL ENGINEERS (GLASGOW SECTION).—At the meeting held on November 12th, the chairman, Prof. Frances G. Baily, delivered his inaugural address to this Section.

INSTITUTION OF ELECTRICAL ENGINEERS (LEEDS SECTION).—We have received the booklet of Rules, &c., with dates of meetings, as follows:—

November 25th.—Mr. W. H. F. Murdoch on "Magnetic Testing of Iron."
December 19th.—Mr. W. B. Woodhouse on "The Commercial Aspects of Power Supply."
January 23rd, 1908.—Dr. Pohl on "The Development of Turbo-Generators."

Meetings will also be held on February 17th, March 19th and April 9th (annual general meeting).

THE JUNIOR INSTITUTION OF ENGINEERS.—A visit of this Institution was recently paid to the Blackfriars Bridge Widening Works, through facilities kindly extended by the engineer, Mr. Basil Mott, M.Inst.C.E. The members, about one hundred in number, were received by the resident engineer (Mr. D. Anderson) and Mr. Cunningham, engineer to the contractors, Messrs. Sir William Arrol & Co. The existing fascia and parapet on the up river side are being removed for the insertion of three additional ribs at 10 ft. centres, increasing the width by 30 ft., and making the distance between parapets 105 ft., the roadway to be 73 ft. wide and each footpath 16 ft. The L.C.C. tramway will be laid on the western side. The air compressors, cranes, hoists, &c., are worked electrically by current supplied from the public mains, so that the smoke nuisance may be entirely avoided.

SOCIETY OF ARTS.—On November 29th, Dr. Scott Haldane, F.R.S., will give the first of a series of six lectures on "Industrial Hygiene," under the bequest of the late Mr. Benjamin Shaw, for the promotion of industrial hygiene. Mr. Haldane's lecture will deal with the hygiene of work in compressed air. The other lectures will include one by Prof. Thomas Oliver, M.D., on "Industrial Poisons," one by Dr. Haldane on "The Removal of Dust and Fumes in Factories," and one by Mr. W. E. Garforth on "The Dangers of Coal Dust and their Prevention."

The following arrangements appear in the programme for the session:—

Wednesday, November 27th, 8 p.m. (Ordinary Meeting).—The Hon. Sir John A. Cockburn, K.C.M.G.: "The Franco-British Exhibition, 1908."
Wednesday, December 11th, 8 p.m. (Aldred Lecture).—Sir William Ramsay, K.C.B., Ph.D., F.R.S.: "Radio-Active Phenomena."

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—On Wednesday last week Mr. J. S. E. de Vesian, M.Inst.C.E., read a paper on "Ferro-Concrete and its Applications to Engineering Construction." Details were given of the constituents and properties of reinforced concrete, with constructional data, and a number of examples of its use were described.

Liverpool and District Electric Association.—The members of this Association paid a visit to the Mersey Railway generating and pumping station, Birkenhead, on Saturday, 2nd inst. On Tuesday, November 5th, a meeting was held at Chapman's Vegetarian Restaurant, Eberle Street, Liverpool, when a discussion on "The Commutation of Direct-Current Machines" was opened by the hon. secretary and treasurer, Mr. S. Frith, the chair being taken by Mr. W. H. Hamilton. In the course of his remarks, Mr. Frith referred to the effects of cross-magnetisation and demagnetisation, lag and lead, carbon brushes, and auxiliary poles. The next meeting will be held at the Common Hall, at 8 p.m. on Tuesday, November 19th, when there will be some further discussion on this subject, which is of such wide interest. On Tuesday, December 17th, the Association expects to have a lecture, illustrated by limelight views, which will be an open meeting, and an invitation will be extended to all persons interested in electrical matters to be present.

Tramways and Light Railways Association.—The annual dinner will be held at Princes' Restaurant on December 4th, at 7.30, the president, the Duke of Argyll, presiding. On the afternoon of the same day Mr. Fell, chief officer of the L.C.C. tramways, will receive members at 4 p.m. at the generating station of the L.C.C. at Greenwich, to show them over the station. It is stated in the current issue of the Association's *Journal* that all arrangements are completed for conducting the case of the Association in the Fuses and Heat Coils Arbitration, and the appointment by the Board of Trade of an arbitrator is now expected any day. The examination of witnesses by the Brakes Inquiry Committee has now come to an end, and the members of the Committee are engaged in the preparation of their final report. Several meetings will be held during November.

Appointments Vacant.—City electrical engineer for Sydney (N.S.W.) £900; switchboard attendant for Clacton U.D.C. (30s.); assistant junior demonstrator in the electrical engineering laboratories at the Northampton Institute (£80).

Rate of Magnetisation.—Attention may be directed to a short paper in the *Annalen der Physik*, No. 8, 1907, where Mr. Martin Gildemeister describes some useful investigations as to the rate of growth and disappearance of magnetisation of iron. It is, of course, common knowledge that when iron is suddenly submitted to a magnetising force an appreciable time is required for the magnetisation to reach a steady value. The slope has been shown by Martens and Klemencic to consist of two parts, one corresponding to an extremely rapid and the other to a comparatively slow change; and between these parts there is a "pause." The slow change has been frequently examined, but the rapid change has been dealt with by only a few experimenters. It requires very accurate measurement of the short interval of time between opening and closing the magnetising circuit. Mr. Gildemeister has for this purpose made use of a Helmholtz pendulum of great precision, and a micrometer contact-screw. His observations were taken in respect of a bundle of very thin wires, and he considers the value of (1) the sudden current at breaking the circuit, due to the induction of the coil; (2) the current due to the growth of magnetisation in the iron; (3) the current due to the capacity of the coil. As a result, he concludes that the rapid change of magnetisation of the thin iron wire falls to half its value in one three-hundred thousandth of a second. It diminishes to one-tenth of its original value in one one-hundred-and-fifty thousandth of a second; and it vanishes altogether in one fifty-thousandth of a second. From one fifty-thousandth to one two-thousandth of a second the magnetisation of the iron remains appreciably steady; this constitutes the "pause." These results appear to us to be of considerable importance in their bearing upon telephony, and upon the design of the rapidly moving parts of high-speed telegraphic apparatus.

Experience with Gas Engines. — At the recent Atlantic City meeting of the American Street and Interurban Railway Association, Mr. Paul Winsor, chief engineer of motive power and rolling stock of the Boston Elevated Railway Co., read a paper on the experience during the past year with gas-engine generating plant at the Somerville Park station.

This station is equipped with two 600-H.P. Crossley gas engines supplied by a pair of Loomis-Pettibone gas producers, the engines being direct-connected with 350-H.P. Crocker-Wheeler generators. The plant was started in May, 1906, and since then there have been no shut-downs, accidents or failures.

Ignition current is supplied by 14-volt generators in connection with floating storage batteries. The igniters originally had platinum tips which were expensive and gave considerable trouble, but during the past four months they have been operated without platinum and with less trouble. The average coal consumption during the period from January to August of this year was 2·034 lb. per KW.-hour, or 1·404 lb. per brake H.P.-hour. This showing is larger than that of last year, when 1·45 lb. per KW.-hour was reported. The paper states that the smallness of this figure was due to errors in weighing and checking coal. During the same period of seven months the coal consumption of the steam plants averaged 3·477 lb. per KW.-hour, thus showing a superior efficiency of 41·5 per cent. for the gas-engine plant.

In conclusion, Mr. Winsor said he believed that a gas-engine plant making its own producer gas will operate at least as reliably as a steam plant and will use from 30 to 60 per cent. less fuel, depending somewhat upon the size of the steam plant with which it is compared. The drawbacks of the gas plant are, first, cost, which approximates $200 per KW. when rated so as to have a 33⅓ per cent. overload capacity; and second, the small size of units, the statement being made that the largest gas engine now built is only of 3,000 KW. capacity.—*Electrical World.*

The Autogenous Soldering of Aluminium.—Writing in a recent issue of the *Chemiker Zeitung*, M. U. Schoop, of Garenne-Colombes, near Paris, describes an improved process for the autogenous soldering of aluminium. Hitherto, he says, although the soldering of iron, copper, and lead has been easily performed, the treatment of aluminium and nickel has proved difficult; that of nickel because the metal becomes brittle and porous at high temperatures, that of aluminium because it becomes coated with a film of oxide. In the case of aluminium the trouble is obviated by employing as a flux an aqueous solution of some alkali metal chloride, *e.g.*, the chloride of potassium, sodium, or lithium. If the metal is only of moderate thickness, the flux may be applied with a brush in the state of a semi-fluid paste; but for heavier work it is more conveniently used as a dry powder, dusted along the joint which has to be made. The result of the soldering operation is to produce a joint quite free from any foreign metal; so that if the aluminium is of good quality it is stated to last well, remaining uninjured in salt water for months. Naturally the permanence of the joint is a direct function of the purity of the aluminium, other metals in which determine local electrolytic action. It is easy to tell whether a joint made in aluminium contains foreign metals or not; for if the article is plunged into water acidulated with hydrochloric acid, bubbles of hydrogen will be apparent to the eye if any electrical action is taking place, and a joint which begins to evolve gas cannot last well.

In the course of his article, M. Schoop quotes some figures showing the mechanical properties of two different specimens of sheet aluminium before and after being soldered autogenously with the aid of one of the fluxes mentioned, one sample being 3·1 mm. thick and the other 7·8 mm. Per square millimetre the ultimate tensile strength of the thick sheet was 10·2 kg. without a joint, and 7·4 kg. across the joint; that of the thin sheet being 9·4 and 10·9 kg. respectively. The yield point, or elastic limit, of the thick sheet without a joint was 5·27 kg. per square millimetre, across a joint 3·1 kg.; that of the thin sheet being 5·7 and 6·02 respectively. The extension of the thick sheet without joint was 31·3 per cent., across the joint 4·5 per cent.; that of the thin sheet being 20·5 per cent. and 6·5 per cent. respectively. When examined under the microscope the structure of the joints was found to appear absolutely identical with that of the rest of the metal.

M. Schoop says that nickel also can be autogenously soldered quite satisfactorily with the aid of a suitable flux; but beyond a statement that the flux he has adopted is "something of the nature of borax," he vouchsafes no information as to its precise composition. A German patent has been applied for to cover the employment of the alkali metal chloride solutions.

The foregoing article has called forth a protest from Herr W. C. Heraeus, of Hanau, who, writing in a later issue of the *Chemiker Zeitung*, mentions that he succeeded in welding aluminium by his own process several years ago, actually showing numerous pieces of chemical apparatus with welded joints at the Paris Exhibition of 1900. Herr Heraeus also observes that the experiments quoted by Herr Schoop as having been carried out at the Conservatoire National des Arts et Métiers in Paris seem to indicate that the thickest sheet aluminium amenable to the Schoop process is 7·8 millimetres in gauge, and that such metal can only be soldered by the Schoop process through some two-thirds of its thickness. On the other hand, much heavier sheets can be treated by the Heraeus method. Herr Heraeus has made several pressure pots, holding some 400 gallons, out of 15-millimetre sheet soldered together by his own process, which have successfully withstood a pressure of 17 atmospheres.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Wallasey U.D.C. has increased the salary of the electrical engineer (Mr. J. A. Crowther) by £50 per annum as from March 31st, 1908.

On the 8th inst. Mr. Wm. Hodgson, who has retired from the chairmanship of the Salford Electricity Committee, was presented with an illuminated address as a mark of esteem, and also with a framed photograph of the members of the Salford Electricity Committee.

The Southport Corporation Electricity Committee has appointed Mr. A. S. Black as borough electrical engineer (£350 per annum) from the 1st prox. Mr. Black has satisfactorily discharged the duties since the resignation of his predecessor, Mr. R. S. Downe, a few months ago.

Mr. H. D. Coombs, of Whitchurch and Pangbourne Supply Co., and Mr. H. Strong, of St. Helens Corporation, have been appointed switchboard attendants at Loughborough.

On Tuesday Mr. G. W. Partridge, M.Inst.C.E., chief engineer of the London Electric Supply Corporation, Ltd., was married to Alice Mary, daughter of the late Albert Scott, Esq., of Cheltenham, at St. Saviour's, Maida Vale. Our readers will join with us in hearty congratulations.

Buralem T.C., on November 7th, decided to increase the salary of the electrical engineer (Mr. Brenner) to £380 per annum, this to include all claims on account of extra work.

Mr. C. B. Grace, senior charge engineer at the Mansfield Corporation electricity works, having received an appointment under the Admiralty, has been presented by the staff with a French carriage clock in case.

The staff and consumers of the Coatbridge and Airdrie Electric Supply Co., Ltd., entertained Mr. Jas. Donochie, the company's managing engineer, to supper in the Royal Hotel, Coatbridge, on Friday evening, November 8th, on the occasion of his leaving to take up more important work in Glasgow. Dean of Guild Neilson, chairman of the Local Committee of Directors, occupied the chair. Mr. Launchbury, station superintendent and deputy engineer, expressed their regret at losing their managing engineer, and wished him every success in his new sphere. He then presented Mr. Donochie, with a handsome bureau, and a gold bangle for his wife. In responding, Dr. Donochie referred to the happy seven years he had spent in Coatbridge.

The second annual smoking concert of the West Ham Corporation Electric Supply took place last Monday evening at the Pigeons Hotel, Romford Road. Mr. A. H. Seabrook, engineer and manager, presided, supported by Mr. Alderman Littler, chairman of the Committee. In the course of the evening a large photograph of the Department's outing last summer, handsomely framed, was presented to Mr. Seabrook by Mr. Alderman Littler on behalf of the members of the staff.

General.—The Council of the Royal Society has recommended that Lord Rayleigh, O.M., be elected president for the ensuing year at the meeting to be held on the 30th inst.

Mr. Cecil J. Grimes, who for the past 3½ years has been Messrs. Preece & Cardew's assistant resident engineer at H.M. Dockyard, Devonport, in connection with the installation of electric light and power in the Naval establishments of that port, has received an appointment under the Commissioners for the Port of Calcutta, and will shortly leave for India.

The indoor staff at Swansea of the National Telephone Co. has presented a marble clock and bronzes to Mr. A. E. Coombs, exchange manager, who is leaving for the Bristol district.

The Electrical Review tenders its hearty congratulations to Sir John Irving Courtenay, upon whom the King has conferred the honour of knighthood. Sir John is Chairman of the City Liberal Association, but, as our readers well know, he has been associated with the electrical industry in this country for many years. The Electrical Power Storage Co., Ltd., the Chelsea Electricity Supply Co., Ltd., the Electric Construction Co., Ltd., the United River Plate Telephone Co.—these are some of the electrical undertakings with which he is at present connected, as chairman or managing director, or both.

NEW COMPANIES REGISTERED.

British Arc Lamps, Ltd. (95,437).—This company was registered on October 29th, with a capital of £3,000 in £1 shares, to acquire certain patents relating to electric lights, to adopt an agreement with E. S. M. Perowne, and to carry on the business of lamp manufacturers, electricians, manufacturers of and dealers in motors, rheostats, electric fans and fittings, &c. The first subscribers (each with one share) are:—W. Schuer, 1, Cloudesley Square, N., electrical engineer; J. Milner, Maxwelton, College Road, Wealdstone, secretary; G. W. Elliott, Audley Road, Hendon, bank manager; H. E. West, 1, Coningham Road, Shepherd's Bush, W., accountant; J. Hobart, 35, Montrose Avenue, Kilburn, W., merchant; W. A. Watson, Homeleigh, Bengal Road, Ilford, secretary; and W. H. Fox, F.S.A., The Priory, Wymondley, Herts. No initial public issue; the number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, 200 shares.

Bradford Electrical Engineering Co., Ltd. (95,462).—This company was registered on October 30th, with a capital of £3,000 in £1 shares, to adopt an agreement with C. J. Casse and H. H. Casse for the acquisition of the business carried on by them at 3, Royal Arcade, Manningham Lane, Bradford, as the Bradford Electrical Engineering Co., and to carry on the business of electricians, electrical and mechanical engineers, producers of and dealers in electricity, motive power and light, &c. The first subscribers (each with one share) are:—C. J. Casse, 3, Royal Arcade, Bradford, electrical engineer; H. H. Casse, 3, Royal Arcade, Bradford, electrical engineer; A. Whitehead, 7, Laisteridge Lane, Bradford, wool buyer; J. Garnett, 40, St. Paul's Road, Bradford, milliner; J. H. Haley, 29, Tyrrel Street, Bradford, incorporated accountant; W. I. Crabtree, 36, Sunbridge Road, Bradford, solicitor; and W. Haigh, 29, Tyrrel Street, Bradford, managing clerk. No initial public issue. The number of directors is not to be less than three or more than seven; the first are C. J. Casse (managing director), H. H. Casse, A. Whitehead (chairman), and J. Garnett; qualification, £50.

T. W. Broadbent, Ltd. (95,420).—This company was registered on October 26th, with a capital of £5,000 in £5 shares (440 preference), to acquire the business of an electrical engineer carried on by T. W. Broadbent at the Victoria Electrical Works, East Parade, Huddersfield, and to carry on the same and the business of electricians, mechanical engineers, suppliers of electricity for motive power and light, &c. The first subscribers (each with one ordinary share) are:—T. W. Broadbent, Hillside House, Kirkheaton, near Huddersfield, electrical engineer; G. A. Broadbent, 33, Cleveland Road, Huddersfield, land surveyor; F. W. Davies, 55, Newsome Road, Huddersfield, electrical engineer; R. Broadbent, Walden, Kirkheaton, near Huddersfield, secretary; J. Broadbent, Kirkfield House, Kirkheaton, near Huddersfield, assistant superintendent P.O.; J. E. Broadbent, 64, Dunford Road, Holmfirth, secretary; and Mrs. A. P. Broadbent, Hillside House, Kirkheaton, near Huddersfield. No initial public issue. The number of directors is not to be less than two or more than five; the first are T. W. Broadbent, G. A. Broadbent and F. W. Davies; qualification, £100; remuneration as fixed by the company.

F. W. Smith & Co. (1907), Ltd. (95,563).—This company was registered on November 6th, with a capital of £5,000 in £1 shares to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers (each with one share) are:—F. W. Smith, 57, Forest Road, Southport, electrical engineer; A. F. Stephenson, jun., 14, Morley Road, Southport, newspaper manager; C. Leigh, 13, Post Office Avenue, Southport, incorporated accountant; A. E. Mitchell, 21, Pine Grove, Southport, secretary; R. Pilkington, 2, Norwood Grove, Southport, electrical engineer; H. Bentham, 89, Liverpool Road, South, Birkdale, electrical engineer; and A. E. Sudlow, 9, Charlton Road, Levenshulme, Manchester, electrical engineer. No initial public issue. F. W. Smith is sole governing director, and may retain office for life. Registered office, 86, Chapel Street, Southport.

Joseph Evans & Sons (Wolverhampton), Ltd. (95,446).—This company was registered on October 29th, with a capital of £125,000 in £1 shares, to acquire the business carried on at Heath Town, Staffordshire, as "Joseph Evans & Sons," to adopt an agreement with J. Evans and W. Evans, and to carry on the business of hydraulic, mechanical, electrical, water supply and general engineers, ironfounders, ironmasters, colliery proprietors, manufacturers of pumps, pumping engines and mining apparatus, millwrights, machinists, iron and steel converters, smiths, metallurgists, hardwaremen, &c. The first subscribers (each with one share) are:—J. Evans, The Lindens, Wolverhampton, engineer; W. Evans, Westlands, Wolverhampton, engineer; J. O. Evans, The Lindens, Wolverhampton, engineer; W. H. Evans, The Lindens, Wolverhampton, engineer; G. H. Evans, The Lindens, Wolverhampton, engineer; J. R. Perry, The Uplands, Bath Road, Wolverhampton, cashier; Miss M. C. Swift, Westlands, Compton Road, Wolverhampton; and Miss F. Evans, Westlands, Compton Road, Wolverhampton. No initial public issue. J. Evans and W. Evans are permanent governing directors; special qualification, 5,000 shares; remuneration as fixed by the company.

Gatti Jewel Manufacturing Co., Ltd. (95,486).—This company was registered on October 31st, with a capital of £5,000 in £1 shares, to adopt an agreement with A. M. C. Gatti, and to carry on the business of dealers in gems, cutters of precious stones, manufacturers of watch and chronometer jewels, jewels for scientific and electrical measuring instruments and iridium points, dealers in Bort carborundum and diamond powder, &c. The first subscribers (each with one share) are:—W. Harrad, 13, Charterhouse Road, Coventry, clerk; T. Longmore, 5, Broomfield Road, Coventry, clerk; H. W. S. Grimes, Crosslands, Whitley, Coventry, solicitor; J. Davies, 38, King Richard Street, Coventry, accountant; W. Coleman, 63, Hartlepool Road, Coventry, clerk; A. H. Jarrard, 70, Swanswell Street, Coventry, clerk; and R. J. Sawers, Coventry, solicitor. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Waddle Patent Fan and Engineering Co., Ltd. (95,594).—This company was registered on November 7th, with a capital of £90,000 in £50 shares, to take over the business carried on at Llanelly, as the "Waddle Patent Fan and Engineering Co.," and to carry on the business of engineers, manufacturers of ventilating fans and other machinery, electric engineers, &c. The first subscribers (each with one share) are:—Miss M. H. Waddle, Horringdon Farm, Claygate; A. J. H. Burn, Old Road, Llanelly, engineer; Mrs. E. M. Burn, Old Road, Llanelly; H. S. Burn, 20, Pembrey Road, Llanelly, accountant; W. W. Brodie, 1, Park Street, Llanelly, solicitor: W. P. Abell, Castle Hill, near Derby, civil engineer; and T. Jones, Brynmair, Llanelly, gentleman. No initial public issue. The number of directors is to be three; the first are A. J. H. Burn, W. W. Brodie and H. D. Evans; qualification, £500; remuneration, £150 per annum, divisible. Registered office, Llanmore Works, Llanelly, Carmarthen.

Northern Engineering and Construction Co., Ltd. (95,550).—This company was registered on November 5th, with a capital of £3,000 in £1 shares (60 founders'), to adopt an agreement with C. A. Esmarch and J. S. T. Walton, and to carry on in Newcastle-on-Tyne and elsewhere the business of electricians, mechanical engineers, suppliers of electricity, manufacturers of and dealers in engineering goods, machinery and cranes, &c. The first subscribers (each with one share) are:—H. Casper, The Grove, Linthorpe, Middlesbrough, shipowner; T. Lynas, Stonefield, Linthorpe, Middlesbrough, gentleman; J. Scorer, Bonnersfield, Sunderland, engineer; C. C. Bell, St. Fallans, Stockton-on-Tees, bank manager; J. Litbgow, 53, Southfield Road, Middlesbrough, auctioneer; C. A. Esmarch, Brigwood, Haydon Bridge, Northumberland, engineer; and J. S. T. Walton, Sunniside, Stocksfield-on-Tyne, merchant. No initial public issue. The number of directors is not to be less than three or more than five; the first are H. Casper, C. A. Esmarch (chairman) and J. S. T. Walton; qualification £100. Registered office, 17, Collingwood Street, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kingston & Co., Ltd. (89,727).—The statutory report, dated September 18th (filed October 8th) shows 963 shares taken up out of a nominal capital of £2,000 in £1 shares. £963 is considered as paid. No mortages or charges registered.

Western Electric Co. (Australia), Ltd. (94,135).—The statutory report, dated October 7th, shows 7 shares taken up out of a nominal capital of £2,000 in £1 shares. No calls have been made. No mortgages or charges.

Spagnoletti, Ltd. (Electrical Engineers, London), (94,447).—Issue on October 22nd of £10,500 6 per cent. debentures, part of series created by resolutions of August 12th and October 22nd, 1907, to secure £12,500. Property charged: Freehold land with buildings thereon in Woodger Road, Shepherd's Bush, W., known as the Goldhawk Works, and the company's undertaking and property, present and future, including uncalled capital and leaseholds. Trustees:—J. E. Spagnoletti, Goldhawk Works, Goldhawk Road, Shepherd's Bush, W.; and G. J. Lothian Nicholson, Albany Buildings, York Street, Westminster.

Frederick Braby & Co., Ltd. (2,537c).—This company's annual return, made up to August 29th, was filed on October 10th. 20,000 ordinary and 2,500 preference shares have been taken up out of a nominal capital of £250,000 in 22,500 ordinary and 2,500 preference shares of £10 each. £9 per share has been called up on 13,230 ordinary, £8 per share on 3,590 ordinary, £5 per share on 3,250 ordinary, and £10 per share on 2,500 preference, resulting in the receipt of £170,900, including £20 paid on five shares forfeited. £18,000 (£4 per share) is considered as paid on 3,250. Mortgages and charges: £55,000.

Halifax and Bermudas Cable Co., Ltd. (28,972).—This company's annual return was filed on October 3rd, when the entire capital of £50,000 in £5 shares had been taken up. £50,000 is considered as paid. Mortgages and charges: £28,900.

CITY NOTES.

The Eastern Extension, Australasia and China Telegraph Co., Ltd.

The 68th half-yearly meeting of this company was held on Wednesday at Electra House, Sir J. Wolfe Barry, K.C.B. in the chair.

The Chairman, in proposing the adoption of the report (see Electrical Review, November 18th, page 781), said that the gross revenue for the half-year amounted roundly to £304,000, or a few hundred pounds more than in the corresponding period of 1906. In the latter period there was an exceptionally large profit made from exchange, and if that were excluded from the comparison, the receipts would show an increase of about £8,000 derived from the natural growth of the traffic. With regard to the expenditure, the working and other expenses amounted, in round figures, to £156,000, against £141,000, showing an increase of nearly £15,000. Of this, £3,000 was due to the increased cost of maintenance of cables; £2,000 to additional cost of maintenance and renewals of instruments and electrical apparatus, and most of the balance was accounted for by the supplemental allowances which it was found necessary to make to the staff to meet the continued rise in exchange in the value of the dollar in the Straits Settlements and China, together with the exchange differences affecting the general expenditure in those countries due to the same cause. To appreciate the detrimental effect which the rise in exchange had upon the European staff serving in the Far East, it was necessary to mention that their salaries and foreign service allowances were fixed in sterling and converted into currency at a rate regulated by the rate of exchange of the day. Consequently, when the value of the dollar rose from 1s. 9d. to 2s. 4d., and their staff therefore received about 8½ dollars for each pound of their salary instead of nearly 11½ dollars, while the purchasing power of the dollar had by no means increased correspondingly with the rise in exchange, the directors felt bound to grant suitable relief under such unfavourable circumstances. The growth of their working expenses, and their increased ratio to gross receipts, appeared to be continuous and unavoidable. This was caused to some extent by the prosperity of the countries which they served, but in a larger degree by the increased amount of work which they had to do for the same or less revenue. Consequently when reductions of tariff came up for consideration, it was necessary to bear in mind that any increase in the volume of traffic which might be expected from such reductions must, by the fact of increase of volume, add to the actual amount of the working expenses as well as to their ratio to the revenue earned. The net profit for the half-year was, roundly, £132,000, and after adding to the credit balance of £17,344 brought forward from the previous half-year, there remained an available balance of roundly £150,000. The usual quarterly interim dividends of 2s. 6d. per share, or at the rate of 5 per cent. per annum, had been paid for the past half-year, leaving a balance of roundly £75,000 to be carried forward. During the past half-year some of their main line cables had been partially renewed at a cost, after making allowance for the value of the picked-up cable, of £9,565, and this amount had been charged against the general reserve fund. The directors had also considered it advisable, in view of the continued heavy depreciation in the value of all gilt-edged securities, to debit the general reserve fund with £120,000 as a provision on account of investment fluctuations, which sum had been deducted from the cost of the investments. As the shareholders would have received with the report a statement of the remarks he made a fortnight ago at the general meeting of the Western Telegraph Co. in regard to the developments of wireless telegraphy, it was unnecessary for him further to allude to the subject on the present occasion.

The Marquis of Tweeddale seconded the motion, which was adopted without discussion.

London Electrobus Co., Ltd.

The directors' report, which was submitted to the meeting held at the Hotel Cecil on Wednesday, in placing before shareholders the statement of accounts for the period from April 11th, 1906 (the date of incorporation of the company), to July 15th, 1907, stated as follows:—

"The attacks which the company was subjected in its early stages materially interfered with the plans of the directors as proposed in the prospectus, and the consequent withdrawal of so much subscribed capital has naturally retarded the operations of the company. Your directors are satisfied that the Electrobus has come to stay, and the trading results accrued since July 15th, 1907, confirm the original opinion which they held, that electric traction was the solution of the passenger traffic problem for the London streets. The results of the working since that date will be fully given to the shareholders at the meeting, and will confirm the original anticipations held out. The initial outlay in a new enterprise of this important nature has necessarily been considerable, but the results already obtained afford evidence of permanent profitable revenue. From the inception of the company to the date of the balance-sheet a considerable sum has been expended on developments and demonstration of the advantages of the company's system, which sum represents outlay on capital account and, of course, will not recur. No amount has been allowed for depreciation, as the 'buses have only started in regular service since the month of July, and it should be borne in mind that the electrobus should not require the same expense for renewal or mechanical attention as other types of 'buses. Your directors would point out that the motive power is dependent upon the all-important question of accumulators. After experimenting with a number of various accumulators, the company is at present principally operating with the Gould and Tudor batteries, which have both proved reliable and efficient, and in this particular the board have agreements unexpired for three years, under which the battery cost is 2d. per mile. The garage at 45, Horseferry Road, and the charging plant and accumulator galleries at 1, Earl Street, Westminster, are now equipped sufficient for handling 50 to 60 'buses."

Mr. Philip E. Beachcroft presided at the meeting, and in moving the adoption of the above report, said that he desired to summarise what the directors had been doing in the last 15 months, which was the period which the balance-sheet covered. The reason for the extension of the time over 15 months was mainly due to the criticisms which, as they knew, were freely cast at them at the company's inception. At the time these criticisms were made he and his colleagues were asked why they continued to stand at the head of it, but they were possessed of that pertinacity or obstinacy, or whatever they called it, which was the characteristic of Englishmen. The board believed that what they set forth in the prospectus was true in fact, and he was going to demonstrate to them that the figures given in the prospectus were absolutely correct. The first proceedings which the directors took after dealing with the many law-suits and various matters which came before them at that unfortunate time, were to get in sufficient capital to replace the withdrawals which took place. Originally there were 126,000 shares applied for by the public, and practically the whole of that capital was returned by the directors, not because at that time there was any real flaw in the prospectus, but because they refused to have as their constituents shareholders who were so eager to get out. The actual shares issued at the present moment were about 46,000, which were mainly held by the friends of the directors, who believed in the potentiality of the electric 'bus. He was exceedingly glad to feel that these gentlemen, who had had the pluck to go forward, were going to reap their reward. At the same time, the criticisms to which they were subjected enabled them to modify the terms in the prospectus. The patent question was eliminated altogether, and there was no liability with the company whatever in regard to the consideration to be paid under that point. In regard to the contract for the 'buses, that was cancelled and a new contract was entered into, which was now being carried out by the Electric Van and Wagon Co. A sum of £20,000 was eliminated entirely from the capital as not being payable by the company, and the deferred 5,000 shares were retained for future service, and that was very material. They would find that the directors had expended a very considerable amount of capital, and that was due in order to prove to the shareholders that the 'bus could do what it professed to do. In order to arrive at that stage, it was essential to have a very complete garage and electric installation. That they had got with the assistance of the Electric Construction Co. They had a generator which was not for the actual generating of the current, but for the transformation of the current. The garage was quite an object lesson, and he invited shareholders to visit it. Now the burden of the criticism was directed almost entirely upon the accumulators. It was said, and emphatically said, by various so-called experts in the Press, that accumulators could not be successfully and commercially adapted to heavy motor traffic. In fact, it was stated that it was only suitable for light vehicles. There was, however, a great difference between the accumulator on a cab and one on an omnibus. A cab started from one point and went goodness knew where, and a large amount of its energy was wasted. The cab might go from Charing Cross to Hampstead and get a passenger on the return journey. On the other hand, the omnibus started from one point and went to a given point, and, therefore, they could at once calculate what was the amount of energy which would be required, and there would be no waste. They had in their accumulators 44 2-volt cells of 500 hours' capacity, and the mileage which these batteries could run, allowing for over 30 per cent. reserve, was equal to 36 miles. He wanted that to sink into their minds, as it was a most material point. As a matter of fact, the accumulators which they were now running were the accumulators of the Tudor and Gould companies, and those companies were entirely satisfied with the contracts they had entered into with the company. A great deal of criticism was directed to the life of the accumulators, and it was a matter which gave the directors some concern; for, after all, they were the pioneers of the adoption of accumulators for heavy vehicles—at least, in this country. The results which they had found by their experience had proved that the accumulator had a very good life. In other words, the depreciation was infinitesimal to what was anticipated at the start. They could run four journeys from Victoria to Liverpool Street, and had done five journeys, which was equal to just under 40 miles, with one charging. It was a matter which gave immense satisfaction to the board, as it absolutely refuted the adverse criticism which had been made with regard to the use of accumulators for heavy traffic, which was, of course, the most important and material point. They had under their contracts provided for sufficient accumulators, as they might require up to 50 or even 100 omnibuses, at 2d. per car-mile. The chairman proceeded to deal with the figures stated in the prospectus, to prove that these statements had been absolutely borne out by the facts. In the prospectus they estimated that it would cost £4 9s. to run a 'bus 120 miles, made up as follows:—Two drivers at 6s. 6d.; two conductors at 5s.; 120 miles tires at 1½d. per mile; accumulators, £1. They had paid their drivers and conductors as stated, their contract for tires was as stated, their current cost them 1d. per unit, and they consumed a little under one unit per car-mile, so that they were somewhat under the figures given in the prospectus. The garage and cleaning was 5s., insurance was 3s., which was 1s. under the figure in the prospectus, and the depreciation was 5s. As to administration expenses, he admitted

that they were high in consequence of the fact that they had but six or seven vehicles running, whereas their garage was capable of taking 60 to 70 omnibuses. Therefore, while at the present moment their takings were in considerable excess of their actual expenses outside their administrative expenses, yet they must not lose sight of that actual fact. Their figures showed an actual cost of 9d. per car-mile. They were told that their accumulators alone would cost 10d. per car-mile, but their total costs, including everything, was 9½d. per car-mile. They commenced running 'buses on July 15th, and from that date to October 31st, they were only running between four and five omnibuses. On four omnibuses they carried 227,000 passengers, having run 20,416 miles, and earned £1,172, or an average rate per car-mile of 13·79d. From November 1st to the 12th, they had one additional 'bus, and in that short period they carried 43,000 passengers, and earned 1s. 3d. per car-mile. Thus they had run at a cost of 9½d. per car-mile, and earned 1s. 3d. Now, assuming that their expenses were 10d. a car-mile, and their earnings were only 1s., that would give a profit of 2d. per car-mile, and with 80 'buses running, they would make a profit of £40,000 a year. In the prospectus they estimated their takings at £6 per 120 miles. Well, for July and August their takings were £6 10s. 9d. per 120 miles, for September £6 18s. 11d., and for October £7 2s. 10d., and for the half of November £7 8s. 10d. In order to arrive at the earnings of £40,000 he had referred to, he confessed it was necessary to get additional capital, for the omnibuses cost £700 each, and he believed they would want £70,000 more capital. The Chairman concluded by reading the following letter sent that day by Sir Douglas Fox:—"Gentlemen,—From the report and figures which are sent herewith, and with certain full details of the whole of our trials and examination of the electrobus and garage equipment, you will see that estimating on 100 electrobuses, the working costs are 9½d. per car-mile. This figure we have arrived at after making very careful calculations and allowing liberally for maintenance, renewals and depreciation. The same conditions that point to a low cost for maintenance and renewals, also lead to the conclusion that an electrobus should, without difficulty, be maintained in fairly continuous commission. We can see no analogy between the numerous and complicated parts of the petrol omnibus operating under adverse conditions, and subject to frequent ill-usage, and the comparatively few, substantial and simple parts of the electrobus equipment. We, therefore, consider that it is safe to estimate an annual mileage of 24,000 miles, equivalent to 80 miles per day, and 300 days per year. When working in competition with other forms of passenger transportation, the earning power of any vehicle is measured (given the required density of traffic) mainly by its popularity with the travelling public. We found that the electrobus attained practically the same average speed as the mechanically propelled vehicle and accelerated smoothly and quickly from standstill to full speed. The freedom from small vibration, jerky action, and driving noise, the invariable characteristics of petrol omnibuses, are features which seem certain to recommend the electrobus as much to the public as to the property-owners and the authorities."

Mr. J. T. Musgrave seconded the motion.

Several shareholders addressed the board in complimentary terms, and expressed the hope that in any issue of capital those who had stood by the company should be considered.

The Chairman said that in any issue the present shareholders would have the option of coming in on the best terms.

The report was adopted.

Drake & Gorham, Ltd.

The sixth annual general meeting of the shareholders of this company was held on Monday at the offices, 66, Victoria Street, Westminster, Mr. B. M. Drake presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, November 8th, page 780), said it was unnecessary for him to dilate on the disappointment of the directors in being compelled to pass the payment of a dividend this year, but it was, perhaps, a small consolation to see that they were not alone in this respect. Adverse factors other than those referred to in the report had been the high prices of copper, lead and rubber, and the competition of other illuminants, which although admittedly inferior in the matter of luxury and convenience, were nevertheless cheaper to install. They had adhered to their policy of using only the best materials obtainable, and he had no doubt that if times improved, they would have their share of the best class of work. As they were probably aware, the directors had had in view other possible sources of revenue, and had turned their attention to the sale of motor-cars, on which they found their clients were inclined to disburse their available surplus in preference to electric lighting. This branch had already developed considerably, showing satisfactory financial results, and he was glad to say that they had received most eulogistic letters as to the value of the services they rendered to those who had not the technical knowledge to enable them to make a wise choice among the numerous cars that were thrust upon them, or to ensure that the chassis and coachbuilders' work were perfect before they paid for them. Then, too, there was the application of electricity as a means of transmitting power, in which they had done a good deal of pioneer work, the results of which had not yet been apparent in the balance-sheet, though, he hoped, it would bear fruit in the future. They had also devoted a good deal of time and money to the preparation of an elaborate catalogue, which would be circulated during the current year, and could not fail to bring to the notice of users the wide range of the company's operations. The work in hand included the lighting of part of Windsor Castle; also contracts for Lord Ellesmere, Lord Selbourne, Lady Cowper, Lady Stewart, Lady Tate, Sir Phillip Waterlow, Sir Reginald Hardy, Sir Charles Welby, Sir William Farmer, Sir W. Greene, Colonel Shuttleworth, Captain Lyons, Major General Sartorius, the Hon. Gervase Beckett, Mr. Reginald Tatton, Mr. G. Whiteley, Mr. G. J. Cookson, Mr. H. J. Stanton, The Refuge Assurance Co., London Assurance Co., Buenos Ayres and Pacific Railway Co., and in mill work, Messrs Joshua Hoyle & Sons, Messrs. Porrit Bros. & Austin, The Cavendish Mill Co., and The Erewash Mills Co. The sub-company, which dealt with fittings, had been a source of anxiety to the Board, but it was hoped that the extension of its sphere of operations, which was being made, would enable it to show better results in future. The factory had already been the means of introducing improvements in their switchgear, and in developing a new conduit system which had been put to use. Up to the present, as a department, it had not paid its way, but as the works had now as much as they could handle, they were hopeful that this venture had already turned the corner. He might perhaps point out that in the accounts submitted the sum of £479 was included for income-tax, which might appear strange in view of the fact that no dividend was forthcoming. The Income Tax Commissioners, however, called upon them to pay in advance a sum based upon the average profits for the past three years; thus they would reap the benefit in the future, although they had this year paid and written off the income-tax on profits which had not been made. Further, it had been usual to include a proportion of the profit known to have been made on work in hand but not invoiced. In this year's figures the percentage included was much smaller than hitherto in view of the results shown in the accounts for the last year, although they had every reason to believe that the rate was equal, if not greater, than before. Their investments in securities had been taken at their market value on June 30th, which again had meant a heavy writing off in the present year. He would like to mention that as the largest shareholder, the absence of dividend affected him most, and as Mr. Gorham and himself, with their families, held about four-fifths of the total share capital of the company, they might rest assured that they would use their best endeavours to make a better showing next year. They had started the present financial year with several good orders, and had important inquiries in hand, so he hoped that when they next met he would be in a position to report that they had returned to their former condition, and were in a position to pay dividends as usual.

Mr. John C. Forster seconded the motion, and the report was adopted.

Stock Exchange Notices.—The Committee have appointed special settling days as under:—

Wednesday, November 20th.—African Rubber Co., Ltd.—5,000 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 5,000.

And ordered the undermentioned securities to be quoted in the Official List:—

British Electric Traction Co., Ltd.—Further issue of £118,758 4½ per cent. second debenture stock.

South Metropolitan Electric Tramways and Lighting Co., Ltd.—19,570 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 19,570.

Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Victoria Falls Power Co., Ltd.—8,000 preference shares of £1 each, fully paid, Nos. 800,001 to 808,000.

To appoint a special settling day in—

African Rubber Co., Ltd.—5,000 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 5,000.

And to allow the following securities to be quoted in the Official List:—

Victoria Falls Power Co., Ltd.—800,000 preference shares of £1 each, fully paid, Nos. 1 to 800,000.

Western Union Telegraph Co., Ltd.—The report of this company for the year ended June 30th last, as abstracted in the *Financial News*, shows: Revenues, $32,856,406, an increase of $2,180,751; expenses, $26,532,196, an increase of $2,927,124; net revenue, $6,324,210, a decrease of $746,372; interest on bonds, $1.420,061, an increase of $92,086; profits, $4,904,149, a decrease of $838,458; appropriated for dividends, $4,868,096, being the same as for the previous year. Surplus, June 30th, 1907, $16,884,781. The revenues of the company increased by $2,180,751. The increase in expenses was due to the necessary outlay to care for the larger number of messages handled, to the increase of 10 per cent. in the salaries of all the operators in the company's employ (which went into effect March 1st, 1907), and to the continued high prices for all materials used in the maintenance of the lines.

Provincial Tramways Co., Ltd.—The directors recommend for the year ended September 30th a final dividend of 5s. per share on the ordinary shares, free of tax, making a total dividend of 8s. per share for the year; £10,000 has been set aside for depreciation, and £3,000 towards the expenses of the issue of the debenture stock.

Meetings Held Over.—The half-yearly meetings of the West India and Panama Telegraph Co., Ltd., and the Eastern Telegraph Co., Ltd., were held on Wednesday afternoon. An extraordinary meeting of the Victoria Falls Power Co., for altering the articles, was held on the same day. Yesterday the meeting of the British Columbia Electric Railway Co. took place. Our reports of these proceedings will be published next week.

MARKET QUOTATIONS.

Wednesday, November 13th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	..
a ,, Oxalic .. .. per cwt.	38/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	42/-	..
a Ammonia, Muriate (crystal) .. per ton	£33 10	..
a ,, ,, ... per ton	£30	..
a Bleaching powder .. .. per ton	£5 10	..
a Bisulphide of Carbon .. .. per ton	£18	..
a Borax .. .. per ton	£16	..
a Copper Sulphate .. .. .. per ton	£23 10	£1 inc.
a Lead, Nitrate .. .. .. per ton	£31	..
a ,, White Sugar .. .. .. per ton	£32	..
a ,, Peroxide .. .. .. per ton	£32	..
a Methylated Spirit .. .. .. per gal.	2/6	..
a Potassium Bichromate, in casks per lb.	5½d.	..
a Potash, Caustic (75/80 %) .. per ton	£20	..
a ,, Chlorate .. .. per lb.	3½d.	..
a ,, Perchlorate .. .. per l b.	9d.	..
a Potassium Cyanide .. .. per lb.	7d.	..
a Shellac .. .. per cwt.	220/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	..
a ,, Recovered .. .. per ton	£5 10	..
a ,, Lump .. .. .. per ton	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	..
a ,, Chlorate .. .. .. per lb.	3½d.	..
a ,, Crystals .. .. .. per ton	£3 5	..
a Sodium Bichromate, casks .. per lb.	3d.	..
a ,, Cyanide (basis 100 %) .. per lb.	7d.	..
METALS, &c.		
b Aluminium Ingots, in ton lots .. per ton	£166 5	..
b ,, Wire, in ton lots .. per ton	£154	..
b ,, Sheet, in ton lots .. per ton	£144	..
p Babbitt's metal ingots .. .. per ton	£55 to £166	dec.
c Brass (rolled metal 2" to 12") basis per lb.	7d.	¼d. dec.
c ,, Tube (brazed) .. .. per lb.	9¾d.	¼d. inc.
c ,, ,, (solid drawn) .. .. per lb.	8¾d.	¼d. inc.
c ,, Wire, basis .. .. .. per lb.	7¼d.	..
c Copper Tubes (brazed) .. .. per lb.	10¼d.	..
c ,, ,, (solid drawn) .. per lb.	10¾d.	..
g Copper Bars (best selected) .. per ton	£78	£4 dec.
g Copper Sheet .. .. .. per ton	£78	£4 dec.
g ,, Rod .. .. .. per ton	£78	£4 dec.
e ,, (Electrolytic) Bars .. per ton	£66	£3 dec.
e ,, ,, Sheets .. per ton	£83	£3 dec.
e ,, ,, Rod .. per ton	£72	£2 dec.
e ,, ,, H.C. Wire per lb.	8¼d.	¼d. dec.
f Ebonite Rod .. .. .. per lb.	3/6	..
f ,, Sheet .. .. .. per lb.	3/-	..
n German Silver Wire .. .. per lb.	1/7	..
h Gutta-percha, fine .. .. per lb.	5/6 to 6/6	..
h India-rubber, Para fine .. .. per lb.	3/9½	4½d. dec.
Iron, Charcoal Sheets .. .. per ton	£18	..
,, Pig (Cleveland warrants) per ton	50/4½	2/9 dec.
,, Forgings, according to size per ton	From £11	..
,, Scrap, heavy .. .. per ton	47/6 to 50/-	..
,, Wire, galvanized No. 8 .. per ton	£9 15	..
g Lead, English Ingot .. .. per ton	£18 15	..
g ,, ,, Sheet .. .. per ton	£18 17 6	..
m Manganin Wire No. 28 .. .. per lb.	8/-	..
g Mercury .. .. per bot.	£8 5	..
d Mica (in original cases) small .. per lb.	6d. to 1/-	..
d ,, ,, ,, medium per lb.	2/6 to 4/-	..
d ,, ,, ,, large .. per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.	1/1½ to 1/8	1d. dec.
p ,, rolled bars & rods per lb.	1/2 to 1/4	dec.
p ,, ,, strip & sheet per lb.	1/2½ to 1/5	dec.
o Platinum .. .. per oz.	110/-	..
e Silicium Bronze Wire .. .. per lb.	9½d.	½d. dec.
r Steel, Magnet, in bars	£60	..
g Tin, Block (English) .. .. per ton	£141 to £142	£6 dec.
n ,, Wire, Nos. 1 to 16 .. .. per lb.	2/-	..
p White Anti-friction Metals—		
"White Ant" brand .. .. per ton	£45 to £70	..
k Zinc, Sh's (Vieille Montagne bnd.) per ton	£26 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Newquay Electric Light and Power Co., Ltd.—

The first annual general meeting of this company was held at 66, Victoria Street, Westminster, on November 1st. The directors' report for the year ended December 31st, 1906, was adopted, and a 4 per cent. dividend (under Messrs. Foote and Milne's guarantee) is to be paid forthwith. Mr. H. Foote presided, and in his remarks said that the steady and continued progress of the company's business was most encouraging. A greater number of lamps per thousand inhabitants had been installed during the first year's running than in any other small town in England. The accounts presented only dealt with the first five months of the business, but the result of the company's trading for the nine months ending September, 1907, already showed a credit balance, and an estimate of the year's working to September 30th next showed that a gross profit of about £600 would, without doubt, be realised.

STOCKS AND SHARES.

Tuesday Evening.

SEVEN per cent. is too high a Bank Rate for any Stock Exchange business to be active. With the prospect of 8 per cent. looming in the near distance, investment markets looked like coming to the verge of a standstill. But Tuesday mended matters to a considerable extent, and led to general improvement.

Profound relief at the settlement of the railway strike has to some extent helped to neutralise the effect of the monetary stringency. So many trades would have suffered severely in the event of a general strike, that the removal of the apprehension has had a most useful influence in keeping prices steady.

What investors ask, however, is why should they buy stocks when prices go for ever downwards? That prices have reached bed-rock level even yet, only the boldest man would dare to say. This is the reason which checks investment buying by many who recognise how cheap prices are to-day, compared with past levels. That they will not always be so cheap, and that the turn will come when it is least expected, is obvious, and the wise man begins to pick up stock when he thinks it has dropped to a really low level. If the price goes flatter, he can buy more; if it rises, he has at least one cheap parcel.

General as these observations may appear, it is in such investment sections as those we deal with where the prospective purchaser can find securities at prices that promise good improvement in the future, though perhaps they will decline further first. So much depends upon the Bank Rate, which, in its turn, is dependent just now upon the financial situation in New York.

After its heavy, continued fall, Metropolitan Consolidated suddenly shot up 3½ this week. A whisper went round to the effect that it was possible the company might renew its former working agreement with the Great Central, and advances in the stocks of the Great Central went some way to strengthen the impression. The agreement was certainly of much service to both parties, but the Great Central terminated it in order to carry on a flirtation with the Great Western.

Districts are dull, and Underground Profit-sharing Notes pursue the even tenour of their steady fall. The price has lost another half-dozen points within the last week, and now stands at 40. The bitter irony of the situation lies in the fact that it is next June when these Notes are supposed to be paid off at par, £100!

Central Londons continue weak, and Preferred shows a 2 points decline at 84. At 80, the return would be a level 5 per cent. The question of penny fares, and a possible rate-war with the omnibus companies, is a source of considerable perplexity to the market. City and South London moved up 1 in sympathy with the general rise in railway stocks, consequent upon the settlement of the threatened labour dispute.

Eastern Telegraph stocks and Eastern Extension shares are unaffected by the companies' reports, summarised last week, which show expenditure to be on the increase, and also the depreciation in investments to have been drastically dealt with. This last policy, however unpleasant, is undoubtedly sound finance.

Direct United States Cable shares are lower. Anglo-American issues improved upon a sharp bear squeeze. Direct Spanish Preference, pressed for sale upon an unwilling market, fell 15s., and Great Northerns dropped another sovereign, though Indo-Europeans have not altered after their decline. West India and Panama Second Preference again improved, a gain of 10s. taking them to 7⅞. Business has been done at 8, and there is a hope of the shares entering the dividend list after their enforced absence of seven years therefrom.

Marconi shares are slightly easier at about 16s. 6d., and National Telephone stocks gave way, the Deferred falling 2, to 105, upon realisations that might have been compulsory in some cases.

The electricity supply list is somewhat ragged, as regards fluctuations. Charing Cross shares are better again, and there are one or two advances amongst the Debenture stocks. On the other hand, Notting Hill shares have declined, and so have Metropolitan Preference, and Brompton Preference. City of London Second Debenture fell 2, and County of London Second Debenture 1, despite the foggy weather.

In the Traction Department, prices have been mostly swayed by monetary considerations, and the necessity which some people were put to of finding cash. Anglo-Argentine Tramways shares have given way, and the Debenture stock fell 3, upon an amount of less than £500 stock coming to market. British Electric Tractions received no assistance from an inspired encouraging statement in the Press, but have rallied from the lowest. Brush shares have been marked down with them, and the Ordinary are officially quoted at the farcical price of nothing to ten shillings. Belgrano Preference are easier. Cape Trams fell to 5s. on the report, and Metropolitan Electric Preference gave way a little. London United Preference at 8 are 5s. down.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Nov. 5th.	Closing Quotations Nov. 12th.	Business done week ended Nov. 12th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	2⅞%	3⅛%	3⅜%	51 — 54	52 — 55	52½	51½	+1	7 0 11
3,169,870	Do. do. do. 6 % Pref.	Stock	6 %	5⅛%	6 %	6 %	91 — 94	92 — 95	93½	91⅝	+1	6 6 4
3,169,870	Do. do. do. Deferred	Stock	2s.	Nil	½%	1⅜%	13½ — 15⅝	13⅝ — 14½	15¼	12⅛	+ ⅜	12 7 10
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6½ — 7½	6½ — 7½	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	84 — 88	87½	85	—1	4 10 11
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	6½	6⅝	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3½ — 3¾	3½ — 3¾	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	8½ — 8⅝	..	..	— ¾	5 14 8
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710£	Direct United States Cable	20	3 %	3½%	4⅛%	4⅝%	12½ — 13½	12½ — 13½	13	12	— ½	6 19 7
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,900, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	121 —126	121 —126	123½	121	..	5 12 0
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	80 — 83	80 — 83	83½	80½	..	4 4 4
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	99 —102 xd	99 —102	100½	..	..	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	11 — 12	11 — 12	11⅝	11	..	5 16 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½	97¼—100¼	98½	98	..	3 19 7
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100 xd	98 —100	..	..	..	4 0 0
181,127	Globe Telegraph and Trust	10	5½%	5⅜%	5½%	5½%	9 — 10	9 — 10	..	..	..	5 10 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12⅜	12⅛	..	4 12 4
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	30 — 33	29 — 32	..	..	—1	6 5 0
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55 xd	50 — 60	..	..	+1½	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	50 — 60	50 — 60	..	..	..	5 16 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	50 — 60	50 — 60	..	..	..	6 13 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜ — 1	⅛ — ⅝	16/10½	15/-	— ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1 — 1	1 — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —108	107⅛ 107¼	107½	106	— ⅛	5 11 7
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	104 —106	106¼	104	—2	4 14 4
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅜ — 5⅞	5⅜	..	— 1/16	4 18 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	96½	96	..	3 11 10
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101	..	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	6¾%	7 %	7 %	1⅛ — 1⅛ xd	1⅛ — 1⅛	..	..	..	5 13 0
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛ xd	1⅛ — 1⅛	..	..	..	4 16 0
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	90 — 93	..	..	—1	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839£	Reuter's	£8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127	124 —127 xd	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6½ — 7½	6½ — 7½	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,608£	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1 — 1¼	1 — 1¼	..	..	..	4 0 0
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	12½ — 13½	13 — 13½	13	12½	..	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99⅜—101½	99⅜—101⅜	99	98⅝	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7 — 8	7 — 8	8	7⅞	..	10 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½ — 7½	7¼ — 8¼	..	..	+ ⅛	Nil
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,900 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 530,097	5	..	8 %	8 %	8 %	7⅞ — 7⅞	7 — 7⅛	7⅛	7⅛	—1/16	5 6 8
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	5⅛%	5⅞ — 6⅛	5⅞ — 6	6	5⅞	— ⅛	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	128 —131	128½	128	—3	4 11 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	102 —105	..	..	—1/16	4 15 8
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	20 %	3⅝ — 3⅞	3⅝ — 3⅞	7⅝-	7⅜1½	..	5 4 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	3 16 10
38,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	7 %	7 %	7 %	4 — 5 xd	4 — 5	87/6	..	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4½ — 5 xd	4½ — 5	..	..	..	6 10 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4½ — 5	4½ — 5	..	..	..	6 0 0
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3½ — 4¼ xd	3½ — 4¼	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	96 — 99	96 — 99	..	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	128 —133	128 —133	130	129½	..	4 10 3
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	112 —116	112 —116	113½	..	..	4 6 2
300,000	Do. 5 % Cum. Perp. Pref. Stock ..	100	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..	4 15 3
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1⅜ — 2⅛	1⅛ — 1⅜	35/-	25/3	— ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	4½ — 5½	4⅓ — 5	100/-	81/8	— ½	12 0 0
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	94 — 97	94 — 97	95¾	94	..	5 3 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	74 — 78 xd	74 — 78	..	..	..	5 15 5
100,000	British Insulated and Helsby Cables ..	5	8 %	8 %	8 %	10 %	6¾ — 7	6¾ — 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅞ — 1⅛	⅞ — 1⅛	20/6	20/-	..	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1
50,000	‡Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝ — 1⅛	⅝ — 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2⅛%	Nil	½ — ¾	0— ¾	..	..	— ½	Nil
150,000	Do. do. Non-cum. 6 % Pref. ..	2	6 %	6 %	6 %	Nil	⅝ — 1⅛	⅝ — ⅞	..	..	— ½	Nil
125,000£	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	67 — 70	67 — 70	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅞ — 4¾	4⅜ — 4⅝	..	..	—1/16	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4½ — 5½	4⅜ — 5½	96/3	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4½ — 5½	4⅜ — 5½	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	102½	102	..	4 15 3
187,510	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 12 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	100 —104	100 —104	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9½ — 10½ xd	9½ — 10½	..	..	..	7 6 4
40,000	Do. do. 7 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½ — 6½	5½ — 6½	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107½	105½—107½	..	..	..	4 8 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	—1/16	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅝ — 1⅞	1⅝ — 1⅞	27/6	26/6	..	5 11 4
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	98 —102	98 —102	102	100	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	54 — 57	54 — 57	56½	54½	..	7 0 4
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	83 — 85	85	..	— 2	4 14 2
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	40 — 43	40 — 43	41½	..	..	9 6 0
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2⅜%	43 — 45	44 — 46	44½	44½	..	4 14 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Nov. 5th.	Closing Quotations Nov. 12th.	Business done week ended Nov. 12th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
65,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1 13/16 — 1 15/16	1 11/16 — 1 15/16	35/-	33/9	..	7 16 10
100,000†	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..	6 13 4
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅜	12⅞ — 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1 — 1⅛ xd	1 — 1⅛	..	..	— ⅛	9 13 11
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	2 — 2⅛ xd	2 — 2⅛	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	81 — 84	82¾	81¼	—1½	4 15 3
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	3/8	..	— 1/8	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	½ — 1	½ — 1	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1¼ — 1⅜	1¼ — 1⅜	26/3	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½ — 11⅛	10⅝ — 11⅛	..	..	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105½—107½	105½—107⅝	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	5 %	10%	10 %	14¼ — 15⅛	14¼ — 15⅛	..	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1¼%	Nil	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅞ — 8	7⅞ — 8	..	..	..	5 14 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6⅝ — 7⅛	..	..	..	4 0 0
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 0 0
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	— ⅛	5 17 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/32 — 1/16	1/32 — 1/16	1/3	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 3/16	1/8 — 3/16	..	..	— 1/32	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	5/16 — 7/16	5/16 — 7/16	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	½ — ⅝	½ — ⅝	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	27 — 30	27 — 30	..	..	..	6 0 0
150,000†	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	44 — 49	38 — 42	40	..	—7½	11 18 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅞ — 4	3⅞ — 3⅞	..	..	— ⅛	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	75 — 80	75 — 80	75	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98 xd	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8⅛	7 — 8	..	..	— ⅛	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —101	98⅛—101½	..	..	+ ½	3 18 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅞ — 4⅛	3⅞ — 4⅛	82,6	..	+ ⅛	5 2 10
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅝ — 3⅞	3⅝ — 3⅞	75/-	72/6	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 3⅞	3⅝ — 3⅞	..	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 —100	96 — 99	..	..	..	4 0 0
49,486	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3½ — 4½	3½ — 4½	..	..	..	5 5 11
175,000†	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	8⅝ — 9⅜	8⅝ — 9⅜	9⅛	9⅛	..	6 3 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅛ — 11⅛	10⅛ — 11⅛	11⅛	..	..	5 11 8
400,000†	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	95 — 98	98	97	— 2	4 11 10
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3⅛ — 4⅛	3⅛ — 4⅛	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4⅛%	5 %	5 %	6¼ — 7	6½ — 7⅛	6⅝	6 9/16	..	7 2 10
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
400,000†	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	106 —109	107	..	—1	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 99	95 — 98 xd	..	..	—1	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	½ — 1	½ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1⅛	1 — 1⅛	..	..	..	8 11 5
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	97/6	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅞ — 5⅛	4⅛ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6½ — 7	6⅝ — 7 xd	..	..	..	6 8 7
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8½ — 9⅛	8½ — 9⅛	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1½ — 1⅝	1½ — 1⅝	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 — 4½	3⅞ — 4½	82/6	77/6	— ½	7 1 2
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	89 — 93	89 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ — 5⅛	4⅝ — 5	91/8	..	— ⅛	4 10 0
220,000†	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 10 0
250,000†	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95⅞ — 98½	..	..	+ ½	4 11 5
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11 — 12	10½ — 11½	..	..	— ½	6 10 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅛ — 6	5⅛ — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅛ — 8⅛	7⅛ — 8⅛	7⅛	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 — 7	6 — 7	..	..	..	5 0 0
150,000†	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1⅛	⅛ — 1⅛	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2½ — 2⅝	2⅜ — 2⅝	..	..	..	5 9 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅜ — ½	⅜ — ½	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 10 6
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝ — 2⅜	1⅝ — 2⅜	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	93 — 95	92 — 95	..	..	..	4 14 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8½ — 9⅛	8½ — 9⅛	8⅝	8 11/16	..	6 9 9
61,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4½ — 5½	4½ — 5½	..	..	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpoo Stock Exchange.

Bank rate of Discount 7 per cent., November 7th, 1907.

WAGES AND THE COST OF LIVING IN THE UNITED STATES AND CANADA.

By DUDLEY W. WALTON, New York.

Electrical engineers turning their eyes towards the United States as a possible field for their activities should acquaint themselves with a good many more facts concerning American industrial conditions than can be condensed into this short article. A skilled man, arriving as a stranger in the land, will have to meet the competition of men equally skilled, but in methods largely unknown to Britain. The American workman is pre-eminently intelligent, strenuous and adaptable. The American manufacturer has a selective mind, and organises every detail of his business. Everything is expressed in dollars and cents, and when it is shown on paper that a thing can be made to pay, it is just made to pay. An American firm will readily take on a contract for any new piece of work, even outside its own special province, and the minute office records, divided and sub-divided down to the smallest nut and bolt, will show the probable works cost of every detail of the specification.

The electrical industry is flourishing in all its branches, both in New York and in all the large American and Canadian towns. Firms like the Westinghouse* or General Electric Companies at Philadelphia and Schenectady respectively, are nearly always open for a handy man who will take anything offered and work himself into a better position; but the man who wants the post which he thinks will exactly suit him will have to wait until he gets tired of America. In American electrical engineering the scientific and theoretical work in all departments is of the very highest class, and men with European training, especially Italians, are sure of their reward. No pains are spared to turn out the most efficient generators, the motors best suited in design for every purpose, and the lamp with the longest life.

But the finished product of all this highly organised intelligence is shoddy, a statement which, however, implies no moral censure. An American dynamo designer argues, and proves from experiment that the weakest part of his machine will last, say, four years, and he strives to build a generator, all the parts of which will wear out at the same time. The fable of the Parson's One-Horse Shay, which was built equally strong all over, and finally dissipated itself into dust, is typical of all American mechanical methods. When a machine wears out it is not repaired, but goes to the scrap-heap to be replaced by some newer pattern. The limit of all this practical electrical efficiency (or inefficiency) is found in the pages of the Code Book of the New York Fire Underwriters' Association whose regulations are accepted all over the States, and represent the minimum conditions of wiring and generating risks that the fire insurance companies are willing to accept. British workmen do not take readily to these loose conditions, and on the average it takes a man two years to become accustomed to American methods. But when he is used to it there are possibilities for steady men, and especially for men who can either make other men work, or can obtain the maximum output with the minimum cost.

Industrially, America is a land of liberal patent laws, accurate and fast-working machinery, utilisation of waste products; and on the commercial side, a land of closely interrelated commercial agencies which supply information, quickly and accurately, both of the conditions of trade and of a customer's commercial standing. The reports of the United States Department of Labour contain voluminous statistics. The latest figures accessible show the following relative increases in the electrical industry:—

Relative Increases in the American Electrical Industry.

Year.	Relative number employed.	Relative hours employed.	Relative wages per hour
1890	54	100	98·6
1895	100	100·4	97·3
1900	203	100·1	102·6
1903	249	94·1	110·8

This enormous increase in the number of employés, the appreciable reduction in the hours of employment, and the still more appreciable increase in wages is but a reflex of the recent commercial expansion of the United States. As to wages in the electrical industry, so far as they can be generalised, pattern makers are receiving the equivalent of about £4 5s. per week, brass finishers and machinists about £3, and armature winders about £2 15s. A "machinist" means a man who has served an apprenticeship or is otherwise trained to his work. "Specialists"—that is, men performing a specified and comparatively simple task, earn about £2 5s. Theoretical men can name their own price, many getting £8 a week and a few £15 or even £20.

In a land where distances are greater than can be readily appreciated by the average Englishman, the transportation industry is naturally of primary national importance, and the railways, when competing in the labour market, offer slightly better conditions than the average electrical shop. The following comparative tables are instructive:—

Trade.	Year.	Electrical shops.			Railway shops.			Machine shops.		
		Relative number employed.	Hours per week.	Wages per hour.	Relative number employed.	Hours per week.	Wages per hour.	Relative number employed.	Hours per week.	Wages per hour.
Pattern makers	1890	100	59	15½d.	100	57½	13½d.	100	59	13½d.
	1900	150	59	15½d.	117	58	13½d.	124	58½	14d.
	1903	150	55	18½d.	126	56½	13½d.	132	56	16d.
Machinists	1890	100	58	12d.	100	57½	13d.	100	59	11½d.
	1900	106	58½	13d.	118	58	13d.	130	58½	12d.
	1903	164	55½	13d.	133	56¾	14½d.	158	56	13½d.
Brass finishers	1890	100	59	12½d.	100	59½	13d.	100	59	12d.
	1900	81	59	13d.	103	59¾	13½d.	108	58¼	12d.
	1903	162	55	13d.	101	56	15½d.	142	54¾	13½d.
Armature winders	1890	100	57¾	10½d.	—	—	—	—	—	—
	1900	75	57½	10½d.	—	—	—	—	—	—
	1903	122	54½	12d.	—	—	—	—	—	—

Statistics are also available as to the average hours and wages in 21 American cities. Nothing useful can be deduced from the variations of the hours employed, but almost without exception it may be said that wages are highest in those cities where the cost of living is highest. The wages per hour for machinists in the 12 cities reporting the highest wages are given in the table at the top of page 826.

On an industrial map of the United States all the really important electrical shops would be confined within an approximate triangle stretching between Boston, New York and Chicago, an area embracing the industrial life of the East, and the transportation centres of the Middle West.

* The announcement on October 24th that certain of the Westinghouse organisations were in the hands of receivers does not materially affect the statements in this article. It is quite usual in America for receivers to carry on a business indefinitely; and, moreover, present financial troubles cannot affect the constantly-increasing demand for electrical appliances. In all the newer American towns, for example, electricity does not have to compete with gas. The expansion of electrical engineering on the American Continent is a permanent condition, and there is already more electric traction in a single American city than in the whole of Great Britain.

City.	Days from New York.	Population.	Wages.
Portland, Ore.	5	90,500	18½d.
Seattle, Wash.	5	80,000	18d.
Brooklyn, N.Y.	—	1,300,000	17½d.
New Orleans, La.	2½	290,000	17d.
Memphis, Tenn.	2	102,000	16½d.
Mobile, Ala.	2½	38,000	16½d.
Pittsburg, Pa.	½	325,000	16½d.
San Francisco, Cal.	5	340,000?	16d.?
Dallas, Tex.	3½	43,000	15½d.
St. Louis, Mo.	1½	575,000	15½d.
Little Rock, Ark.	3	38,000	15d.
Pueblo, Colo.	3½	28,000	15d.

The Westinghouse shops near Pittsburg employ over 6,000 men; the General Electric Co. at Schenectady employs over 12,000; and the Allis-Chalmers Works at Chicago and Milwaukee employ over 15,000. Compared with these all the other electrical shops are small. The Westinghouse firms seem to have secured the monopoly of talent, sooner or later annexing the best theoretical men in every department, and studying continually to reduce prime costs. The General Electric Co., however, has the better commercial organisation, its selling agencies covering the globe. The Westinghouse and General Electric Co. are in open competition; the Allis-Chalmers Co. is a volcanic intrusion which is building up a large business especially in unworked fields, its central position giving it an enormous advantage, especially in the Western states.

There is a constant growth of electrical business in the circle within fifty miles of Niagara Falls, and the development of hydraulic power is by no means exhausted. This power, however, is at present used for general manufacturing purposes, and the district is rather a market for electrical goods than a centre of electrical industry. Salesmanship, in America, by the way, is a very fine art.

Excluding Niagara Falls, New York City has the largest generating stations, tabulated as follows :—

—	Metropolitan Railway Co. (surface). KW.	Manhattan Street Railway (elevated). KW.	Kingsbridge power station (subway). KW.	Rapid Transit Co. (surface). KW.	Edison Co. (lighting). KW.
Total rated capacity	38,500	40,000	28,000	50,000	56,000
Total max. capacity	51,700	60,000	28,000	75,000	80,000

The telegraph and telephone systems employ an enormous number of men. There are only two telegraph companies worth mentioning—the Western Union and the Postal Telegraph—both of which cover the United States, and have their headquarters in New York City. The Bell Telephone Co. has a practical monopoly in the industrial East, but much new competition is arising.

In Canada, the Province of Ontario is by far the most important electrical field. The largest Canadian plant is the Toronto City lighting station, followed in importance by the Lachine Rapids Hydraulic Co. and the Ottawa Electric Co. British Columbia is a rapidly developing field. The Canadian Government publishes a monthly "Labour Gazette," price 1½d., which is an invaluable source of information for conditions of work and cost of living in the Dominion. The managers of any of the large companies mentioned will readily answer letters addressed to them on any specific question, but it must be remembered that the United States Labour Laws absolutely prohibit Americans contracting to engage men in a foreign country.

The following table shows the hours of labour, with rate of wages for machinists (that is, men who have served an apprenticeship) as noted by members of the Mosely Industrial Commission, together with an approximate estimate of the additional cost of living as compared with England.

The cost of living in the United States is so well illustrated in this table, that it is not necessary to go into very much detail. A loaf weighing about 20 oz. costs 2½d. in any part of the States; household coal (nearly always anthracite) is about 30s. a ton, short weight. Rent in New York is fabulously high, a six-roomed house (practically unobtainable) being let at £100-£120 a year. A decent wooden ("frame") house can be put up in a city suburb for about £300, and 80 per cent. of such houses are owned by their occupiers. The masses of New York and Chicago live in tenements, or highly-congested flats, with totally inadequate sanitary accommodation. The rent of a four or five-roomed tenement is about £4 a month, and nothing like comfort in New York can be had for less than £100 per annum. Taking New York as the standard both as to the highest wages and the highest cost of living, a man with a family must earn at least £5 a week to be comfortable according to English ideas; but he can live luxuriously and save money on £400 a year. A salary of £5 a week is the wage of a policeman, carpenter, compositor, male clerk and school-teacher; and £8 a week represents the average remuneration of salesmen and managers, and of those who can get results and make other men work. Clothing in the United States is about 40 per cent. dearer than in England. Car rides everywhere cost 2½d. up to about ten miles, and railway fare is 1½d. per mile.

City.	Hours.	Wages.	Extra cost of living.
Buffalo, N.Y.	57	13½d.	25 %
Chicago: Allis-Chalmers electrical shops (highly organised) (overtime 50 % extra) ...	54-55	14½-18½d.	35 %
North-Western R.R. shops...	54-55	13½-16d.	
Cincinnati, O. (well-organised shops)	57	13d. & bonus	25 %
Cleveland	55-60	10s.-14s. day	30 %
" Women (drill-fluting machines)	55-60	5s. day	
East Pittsburg Westinghouse shops (highly organised)...	54	14d.-20d.	25 %
Women (lighter work) ...	54	32s.-36s. week	
Unskilled "specialists" ...	54	10d.	
Apprentices	54	7½d.-9d.	
Hamilton, O. (shops congested)...	59-60	12½d.	25 %
Milwaukee: Allis-Chalmers (highly organised)	54	10s.-13s. 6d. day.	30 %
New York and Brooklyn... ...	54	17½d.	40 %
Niagara Falls, N.Y.	54	13½d.	20 %
Canada (generally)	54	48s. week	10 %
Montreal	55	10½d.	12 %
" Piecework	—	15d.	
Toronto (no overtime rate; wages tend to decrease)	55	11½-13½d.	15 %

In Canada a six-roomed house in a good residential suburb rents for about £35-£40 per annum, and clothes are sold at about English prices.

The obtaining of employment in New York is on an altogether different basis to what a Britisher would expect. The Sunday newspapers, especially the *New York Herald*, are the chief advertising media; but the best positions are usually obtained by means of a "pull." The surest way of obtaining a "soft snap" is to go into politics, which means in the final analysis, selling your vote and the votes of as many men as you can influence. The leaders of Tammany Hall, even when not in power, can dispense all kinds of patronage, from the mayoralty of the city, down to the privilege of selling newspapers on the streets. To give an instance, not unconnected with a huge electrical undertaking. When the Pennsylvania Railroad wanted a franchise, or permission to build their gigantic Thirty-fourth Street Station, the matter was "held up" by the Board of Aldermen for about five years, and suddenly settled in about five hours. When the dust had cleared away, it was found that a contract worth a million pounds had been assigned to a lady whose husband was remotely connected with Tammany Hall. The principal jobs in connection with such contracts are distributed on a political basis. A similar state of things prevails in nearly all businesses. No one does anything for nothing. There is a string to every job, and the only way to get it is to get in the swim and pull somebody else's string.

Written testimonials are of little value, though a letter of introduction, even from an unknown stranger, may be the means of opening a door if properly backed up with impudence. When a man applies for a position, his statements are received at his own valuation, less a discount of 50 per cent. Hence the American virtue of exaggeration. If an applicant appears to be a likely man for a job, a tele-

phonic message to someone who knows him will settle his fate. Any explanation will go so long as it is an explanation. The American employer prefers to back his own judgment, and a man is always given a first chance, and offered every opportunity to "make good." A man is usually dismissed without notice, and if he sees a dismissal coming, he prudently resigns. There are employment agencies which find a position for $5 down, and 10 per cent. of the first year's salary. A man taking up a position of responsibility has to provide himself with a bond from a surety company, whose officials casually investigate his past career, and are prepared to take any average risk, mainly, perhaps, on account of the difficulty for a wrongdoer to hide himself for long in the American community. It is usual for the employer to pay the annual premiums, which may amount to as much as 3 per cent. on the amount of the bond. A guarantee bond for $1,000 is about the amount generally required.

REVIEWS.

Brakes for Tramway Cars. By H. M. Sayers, M.I.E.E. London: *Electrician* Printing and Publishing Co. Price 3s. 6d. net.

Mr. Sayers is with us from the start, and that is a helpful item when a book is to be reviewed. Dealing with the emergency brake, he says that the essence of an emergency is the absence of notice, hence the means of meeting it should be applied automatically by an acquired reflex on the part of the driver.

The emergency brake should be the service brake, and its application will not then call for any effort of selection between alternative brakes at the moment when thought processes are likely to be out of gear. There should be two brakes on a car, either of which will answer the double function, and drivers should be encouraged to use both indifferently.

Later on, however, the author adds a special hill brake to the equipment, which brings us back to three brakes per car, plus the power to reverse the motors. This does not tally with our views so well, for the service brake should be powerful enough to protect the car under all service conditions. Steep hills, when they once get on a line, are fairly permanent, and are to be counted as regular features of the run, so the service brake should live up to them.

Possibly, the simplest solution of the brake problem will be found in an electro-magneto-mechanical track brake for the whole range of service and emergency stops, backed by a one-movement gravity drop brake, which takes charge of the car directly it is down, is utterly independent of other brakes, of the motors, and of the wheels, and is not controllable by the driver when once it is set—a brake, moreover, which can be brought into immediate action by the conductor in case the car begins to run back.

Mr. Sayers opens his book with a chapter on the functions of brakes, and proceeds in the following three chapters to describe and criticise the leading forms of wheel and electric brakes other than track brakes, including regenerative control.

Mr. Sayers thinks that there is not much room for the air brake in this country. If trailers were used, it might be of more value as providing a convenient and powerful form of continuous brake.

The rheostatic brake he condemns, of course, and points out the inherent weakness of all electric brakes in that they rely on the free revolution of the wheels for their action.

The moral of this is: Do away with the wheel brake.

Chapter 4 states clearly the advantages which follow effective sanding, and especially of rail cleaning, neither of which things is given as much attention as it deserves on our tramways.

We should aim at reducing the great gap which exists between the average coefficient of friction on railways and tramways, and a great deal can be done if rail cleaners and watering appliances are used regularly and in sufficient numbers.

From the opening day to the day when the rails are scrapped, the groove is never properly clear on any but a few tramways in the kingdom, and packed dirt increases the tractive effort required of the motors, and decreases the braking effect on falling gradients. If the rails are cleaned thoroughly, sand will not be wanted, for metal to metal gives better braking than metal and metal divided by grit.

Mr. Sayers's book is a pleasant departure from the predominant type in that it is not padded with illustrations of all the brakes that ever were, and by long makers' or patentees' descriptions of each in the text. The book deals in an always interesting way with the whole brake problem, and the name of the author alone is sufficient guarantee of its value to the tramway engineer and manager. May they profit by it.

Introduction à l'Etude de l'Electricité Statique et du Magnétisme. By E. Bichat and R. Blondlot. Second edition. Paris: Gauthier-Villars, 1907.

Prof. Blondlot, the surviving author, has carefully revised this work. It is primarily intended for students preparing for the examinations of the "Facultés des Sciences" and for the entrance examination to "l'Ecole Polytechnique." It is very clearly written, and as a literary work will rank very highly. Anyone studying it carefully will receive an admirable grounding in the elementary theory of electrostatics and magnetism. The authors lay great stress on both the historical and logical development of the subject, and even the most learned electrician can profit by reading the work. The end of the book comes all too soon. The chapter we liked the least is the one on the electric spark. The experimental results of Baille and Mascart are quoted, but the potential differences are given in C.G.S. units. No hint is given as to what governs disruptive discharge. The reference to lightning is somewhat antiquated, considering how enormously our knowledge of the subject of atmospheric potential has been increased during the last few years. The chapters on electrometers and on the applications of electrometers are very thorough and up-to-date, and will be helpful to many. —A.R.

Liquid and Gaseous Fuels. By Vivian B. Lewes, F.I.C., F.C.S. London: Constable & Co. 1907. Price 6s. net.

This book, though of general utility, is, perhaps, more particularly to be valued by the engineer who has to do with internal combustion engines. Though ostensibly a book on the fluid fuels, the author very correctly says that these cannot be divorced from the subject of solid fuel, and in order to preserve a necessary sequence, solid fuel has been considered, and, in the case of peat, at some length.

The author is one of those who recognise that the internal combustion engine will ultimately oust steam from its present proud eminence, and in the peat bogs of various countries he sees a large future source of fuel. His information on this fuel is much to the point.

Peat in its natural state is practically nine-tenths water, and much has to be done to render it fit for fuel. We are accustomed to look on Ireland as the peat country, but, from the figures of this book, it would appear that Sweden possesses 11 times the area that Ireland possesses, Finland 16 times, Russia 80 times, while in Canada and the United States there are even vaster tracts of peat. But even the peat will some day follow the last cob of coal, and then, in default of stored sunlight, a world bankrupt of fuel must look to the sun for its life and energy, and here our author enters on prophecy, and turns to fermentation as the power to produce the fuel of the distant future.

This brings him to the subject of alcohol as a source of heat. Alcohol is a fuel which possesses 12,600 B.Th.U. of calorific value per lb.

To alcohol, and alcohol alone, we are told will posterity have to turn for fuel, and, therefore, the full force of experiment ought at once to be turned upon the problem. A cheerful outlook! but none the less a fact which ought to be drummed home to those careless wasters who throw away half the capacity of the fuel they burn, on the selfish excuse that it will last their time.

Meantime, in the whirligig of geology is there no stored coal that will yet come under dry land, and is there no vegetation being cooked into coal for the benefit of that posterity whose fuel at present seems so doubtful a quantity?

It is interesting in this connection to note the conclusions of the preliminary report of the U.S. Department of Agriculture in 1906. The first was that any engine on the American market to-day operating with gas or kerosene can operate with alcohol without structural change, and there are nineteen other conclusions, the last of which throws doubts on the cheapness of alcohol.

Altogether the world's future does not look hopeful. So far from ultimate combustion, it would appear that we are rapidly approaching a period of refrigeration. But in all this, we note that the author entirely avoids reference to the possible increase of CO_2 in the atmosphere of a fuel bankrupt earth. Vegetation would become luxuriant as in olden times. It seems to us that as CO_2 increases man will become more feeble, and nature may strike a balance and rapidly lock up carbon as of old and bury it under shifting sands to form future coal measures.

As regards liquid fuel, our author takes equally pessimistic views. The present production of liquid fuel from the earth may only represent about a twentieth of the value of solid fuel, but we are told by some authorities that the area of petroleum country so far tapped is a paltry fraction of what still remains.

But the reader must not think that this book is merely a speculative glance into futurity. Its major portion deals with the chemistry of gases and liquids employed as fuels, their testing, their calorific value, the manufacture of gases of various sorts for industrial purposes, details of atomisers for the use of liquid fuel in steam production.

The student will find Chapter III very full of interest, for it deals with the determination of calorific values, Berthelot's values being adopted for the combustible gases.

The section dealing with the injection of liquid fuel into a furnace is excellent, but it is very much too brief. An expert may follow the author in his terse and true statements as to the effect of steam on burning oil, but one has to read very much between the lines, and what is said, while it conveys the author's thoughts admirably to one who has considerable study behind him on the fuel problem, will hardly be so clear to the younger student.

Nevertheless, the gist of the matter is there, and we heartily recommend the book to the engineer who wants to inform his mind on fuel practice.

PROF. KORN'S IMPROVED PICTURE TELEGRAPHY.

By DR. ALFRED GRADENWITZ.

Many an inventor's mind has in the course of the last 30 years been occupied by the problem of making immediately visible, through a telegraph or telephone wire, persons or objects situated at the other end. This problem of "telescopy," however, was soon found to be of so complicated a nature, that present-day science could afford a solution only at a prohibitive cost and with an apparatus of enormous complexity, and these endeavours soon centred on the problem of telegraphically transmitting photographic images of such objects or persons.

As long ago as 1881, Mr. Shelford Bidwell succeeded in transmitting black and white pictures with the aid of a selenium cell. He was followed by Caselli and others, while of those apparatus which have been developed during recent years, the telautographs of Gray, Cerebotani and Gruhn respectively should be mentioned. However, the scope of most of these devices was a rather modest one, being limited to the telegraphic transmission of drawings or handwriting. Prof. Korn, of Munich University, has designed an apparatus by the aid of which not only a system of lines, but the varying shades of any photographic model, can be transmitted to a distance. After satisfactory preliminary tests made a few years ago, the inventor has recently succeeded in improving his process to such an extent that the transmission of pictures from the sending station is carried out far more rapidly, with good definition and sharpness of reproduction sufficient for all practical purposes. Distances of upwards of 1,000 miles have been repeatedly bridged without difficulty, while, according to the principle of the invention, there seems to be no insuperable obstacle in the way of effecting transmission to very great distances and even through submarine cables.

While it is intended for far higher aims, Korn's apparatus shares with its predecessors the use of one organ which, so to say, constitutes the soul of it. This is the selenium cell, which possesses the property of converting fluctuations of light into fluctuations of current intensity. Its electrical resistance, which, in the dark, is fairly high, undergoes a material reduction under the influence of illumination. In the case of a varying illumination, the electrical resistance of such a selenium cell and (if the latter be inserted in a circuit) the intensity of current traversing the circuit undergo corresponding fluctuations. These current variations can be observed at any point of the line, and, by means of suitable devices, are reconverted into fluctuations of luminous intensity. The principle of the invention thus to some extent resembles that of the telephone, according to which sound waves are converted into current fluctuations, to be retransformed into similar sound waves.

On inspecting a sending station arranged according to the Korn process, a Nernst lamp N (fig. 1) will be noted, the light from which is concentrated by a lens L on the original picture, which is wound on a glass cylinder C, in the shape

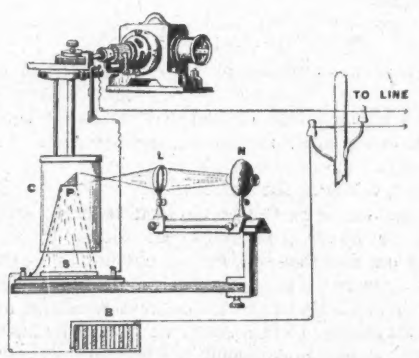


Fig. 1.—Transmitting Station.

of a transparent photographic film. The totally reflecting prism P then projects the light which penetrates the film upon the selenium cell S, situated below the glass cylinder. The beam of light coming from the Nernst lamp and concentrated by the lens is sharply limited by a small window, so that only a very small portion of the photograph is traversed by it, while an illumination of variable intensity (according to the deeper or lighter shades of the portion in question) is allowed to strike the prism, and, after being reflected from the latter, the selenium cell. As the glass cylinder, driven by a motor, revolves upon its axis while advancing in the direction of the latter, all portions of the picture are successively brought in front of the window, in order to be traversed by the beam of light, and to take part in altering the intensity of the beam thrown upon the selenium cell. Owing to the variable illumination of the selenium thus produced, the resistance of the latter, and, therefore, the intensity of the current sent through the line to the receiving station by the battery B, will be altered accordingly.

At the receiving station these fluctuations in current intensity are reconverted into luminous fluctuations by the intermediary of a special chord galvanometer. Between the poles N and S of the upper electro-magnet M (fig. 2) are stretched two thin parallel copper strips, at the middle of which there is fixed a thin aluminium plate of about 1 sq. mm. area. As an electric current traverses the copper

strips, this aluminium plate undergoes a deflection at right angles to the lines of force and in proportion to the current intensity, like the magnetic needle of an ordinary galvanometer. As will be seen from the figure, the light from a Nernst lamp N is concentrated by a lens on the aluminium plate, passing through a slot in the pole N into the pole gap. In the slot of the pole S (which is accurately in front of the first slot), there is a movable lens projecting through a convenient light filter a real image of the image formed in the plane of oscillation of the aluminium plate.

As the deflection of the aluminium plate under the influence of the telegraphic current varies in proportion to the current strength, the intensity of the beam of light which, after passing through the light filter, arrives at the photographic film, will be varied in the same proportion. The film is wound on a glass cylinder similar to that of the sending station. In fig. 2 the photographing chord-galvano-

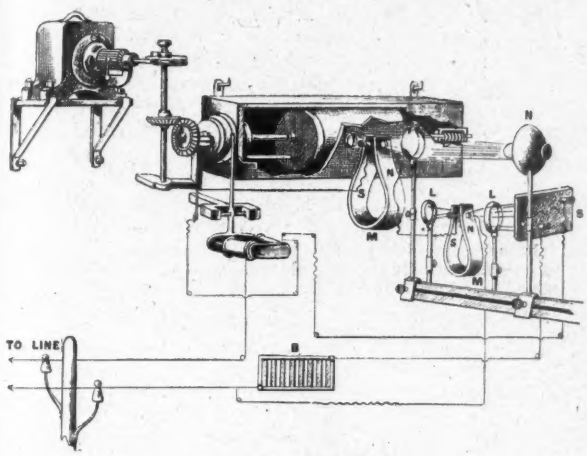


Fig. 2.—Receiving Station.

meter is situated between the poles of the left-hand upper magnet, while the smaller magnet M is part of a similar instrument for compensating the inertia of the selenium. This will be dealt with below.

An important part of the apparatus is the synchronising device, by the aid of which perfect uniformity in the rotation of the two glass cylinders is obtained. It may be said that the imperfect synchronising of the cylinders has hitherto been the greatest obstacle to the solution of the problem of telephotography. The course suggested by Korn consists of accelerating the motion of the glass cylinder at the receiving station. After each revolution the accelerated cylinder is arrested for a moment by means of a convenient interrupter and relay armature, until the difference in speed is accurately compensated for.

Another difficulty was introduced by the inertia of the selenium cell. Though the latter instantaneously follows any fluctuation in luminous intensity by a corresponding variation in resistance, it still shows some residual effect, the action (which at first is limited to the surface layer), gradually spreading to the internal layers of the selenium resistance. Upon the variations in resistance corresponding to the actual fluctuations in light, there are thus superposed the residual effects of previous illuminations, resulting in a very undesirable damping of the total effect and a blurring of the reproduced picture.

This defect was remedied by Prof. Korn in his new apparatus by means of a convenient compensating device. In the receiving apparatus there is arranged a selenium cell (fig. 2, S) similar to that of the sending station, and exposed to precisely similar variations of light by means of an apparatus like that described above, in such a way that its inertia counteracts the inertia of the former cell. The effect of this compensation is quite surprising, and the latest telephotographs show a decided advance over the dim and hazy pictures previously obtained, satisfying all requirements for photographs suitable for reproduction.

The new process will, in the first place, be utilised by the illustrated Press; whereas the photographic illustration of the events of the day in the case of great distances has hitherto had to wait for a few days or even weeks after the telegraphic transmission of the news, it will now be possible to transmit pictures simultaneously with the despatch of intelligence.

The first step in this direction has been taken by the French weekly *L'Illustration*, which is erecting at Paris a central station intended to communicate with other parts of the country as well as with the European capitals, whence telegraphic pictures will be obtained for publication in the journal. In England and Germany similar undertakings are on foot.

While half an hour or more was originally required for transmitting pictures such as the one reproduced below,

Fig. 3.—Portrait of the German Crown Prince, transmitted by Telegraph.

the time of transmission has now been reduced to about 10 minutes, and the process will doubtless be further accelerated in the near future.

The apparatus will, no doubt, prove valuable also to the police in transmitting the portraits of criminals. The same principle can obviously be used in telegraphically transmitting drawings and autographic handwriting, and the apparatus will thus be used also for the purposes of fac-simile telegraphy, in the telegraphic transmission of signatures, receipts, &c.

Taylor's Shop System.—The Taylor system of shop management, in a few words, consists in knowing all about every machine in a works and what it will do. The management of the shop is done in the office rather than in a foreman's office, and the man who orders work to be carried out has information as to what each machine can do in feed and cuts. Thus, a piece of work has to be done, and it is decided to do a portion on No. 1 boring mill and the remainder on No. 3 lathe. A card is got out on which is stated on what speed cone the belt must be run and what must be the feed of the tool, and so on; the man on the machine smartly follows out his orders, and in 21½ minutes, or whatever time he may be given on the card, the piece is finished and a man comes along and bears the work away to the next operation, while the man at the boring mill finds ready to his hand his next job with its line of tools and gauges all ready for his next piece of work.

The system is a cast-iron system, to be put gradually into operation, machine by machine, and it may take several years to get the whole shop into line. The system makes of a machineman an unthinking unit, and has to a large extent, some say, dehumanised the shops, while others say that the human factor depends upon the man at the helm. We are told that practically all the men ultimately get away where the Taylor system is worked, and that an entirely fresh set of men is found to be at work before very long. Undoubtedly it does deprive a man of all incentive to think unless there can be some way of making him take a real interest in his work. Successfully to work the system, the setter-out must know the full capacity of every machine, and all that can be done in the way of speed and feeds, or he may find that he has overloaded or underloaded some of the machines and has lost money. The system says that cast-iron can be cut at such a velocity; steel can be bored at such a speed, a square foot of brass can be finished on lathe No. 6 in so many minutes. It offers no field for the exercise of opinion by the skilled worker, whose skill must be confined to his ability to get the work through at a certain speed. He cannot do it faster than is fixed for him by the hard and fast rule which prescribes the speed of rotation of the face-plate, the feed and the cut. He can improve only on orders in so far as he can get the work fixed in his machine in less time than the card allowance. The system is, it is said, a success.

It appears to us that the system must inevitably bring into the shops a different class of men, not necessarily either better or worse than the pre-existing men, but different in mental constitution, or they could not put up with the new order of things. One thing is certain, the system cannot be rapidly installed, as there is so much to be done in learning what can be done with each tool, and those who fix the rates of work must acquire the experience necessary for the particular machines in use in that particular shop.

THE PARALLEL CONNECTION OF THREE-PHASE TRANSFORMERS.*

The parallel connection of three-phase transformers on one side only—either primary or secondary—presents no difficulties, and can be carried out in every case. When, however, it is desired to put the transformers in parallel on both the primary and secondary sides certain well-defined conditions must be observed. Besides the usual requirements of similarity in frequency and voltage ratio, it is necessary to ensure that the phases of the voltages of the windings which are, respectively, going to be connected together shall be alike. When dealing with single-phase transformers which are

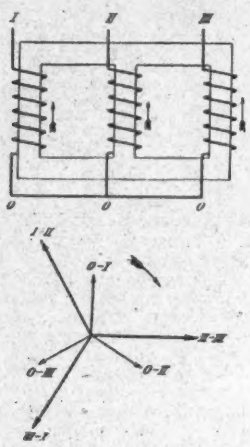


Fig. 1.

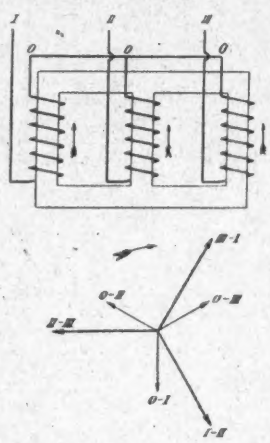


Fig. 2.

connected in parallel on the primary side, and are also to be paralleled on the secondary side, only two possibilities exist—viz., the secondary voltages are either in phase (0°) or they are in opposition of phase (180°) to one another and, by crossing the secondary connections on one transformer if necessary, the former condition must be arranged for when first installing the transformer. With three-phase transformers, however, even when the

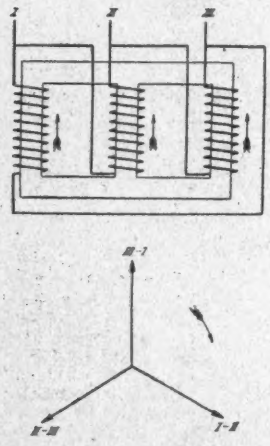


Fig. 3.

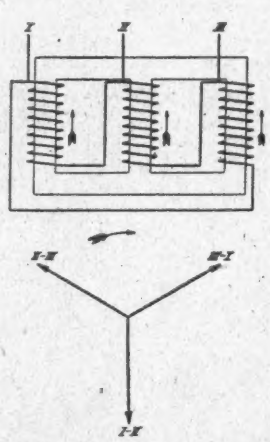


Fig. 4.

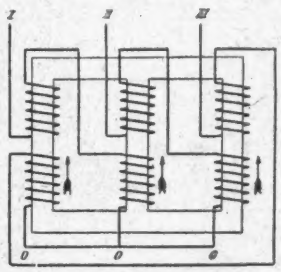
transformation ratio is correct, it may be impossible to parallel on both sides without first making a complete change in the internal connections of the transformer. In the case of generators similarity of phase depends on similar points of the winding being similarly placed relatively to the magnet poles, but with three-phase transformers similarity of phase on both sides can only exist if the windings are arranged similarly so that the same phase displacement may exist between the primary and the secondary voltages on each transformer. In connection with this point the author suggests a new term, "network angle," to represent "the smallest angle of advance in phase which exists between a secondary voltage vector and a primary voltage vector." Three-phase transformers can only be paralleled on both sides, when they are both arranged for the same network angle. With single-phase transformers the network angle can only be 0°, or 180°, but with normal three-phase transformers, four distinct values can be obtained, viz., 0°, 30°, 60°, or 90°.

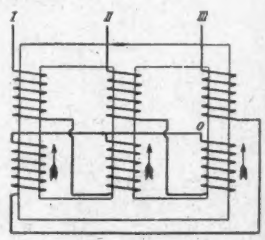
The four cases are shown in figs. 1, 2, 3 and 4. In these diagrams the secondary terminals are shown at I, II and III, and the corresponding voltage vectors are marked I—II, II—III and III—I, whilst the star voltages are shown as 0—I, 0—II and 0—III. The arrows drawn against the winding indicate the positive direction of E.M.F. Taking the direction of the vertical arrows as the common reference direction for all the vector diagrams, it will be seen that the terminal voltages in the two star connections shown in figs. 1 and 2 cannot differ by less than 60° in phase, for in fig. 1 the nearest vector ahead of the vertical reference direction in phase is II—III 90° ahead, whilst in fig. 2 the nearest vector ahead is III—I, which is 30° ahead—the difference in phase between the two being 60°. In the same way the two mesh connections (figs. 3 and 4) differ by 60°.

Since a transformer may have a primary arranged like any one of the four diagrams and its secondary may have either the same arrangement, or any one of the other three arrangements, there are 16 possible combinations, and the network angle or minimum angle of advance of phase between primary and secondary vectors for each of these cases is given below. For the sake of simplicity the convenient symbols, γ, λ, Δ, ∇, are used to indicate the four methods of connection shown in figs. 1, 2, 3 and 4 respectively.

Connections— Primary.	Secondary.	Network angle.
γ	γ	0°
γ	λ	60°
γ	Δ	30°
γ	∇	90°
λ	γ	60°
λ	λ	0°
λ	Δ	90°
λ	∇	30°
Δ	γ	90°
Δ	λ	30°
Δ	Δ	0°
Δ	∇	60°
∇	γ	30°
∇	λ	90°
∇	Δ	60°
∇	∇	0°

It has recently become usual to employ three-phase transformers in which the winding of each phase is split up into two equal parts placed on different limbs of the core, as shown in figs. 5 and 6.





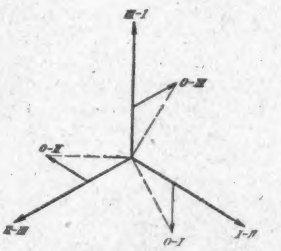


Fig. 5.

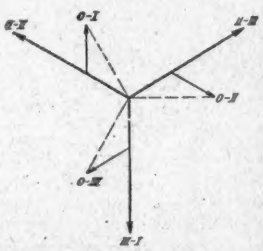


Fig. 6.

A comparison between these diagrams and the previous ones, shows that as regards network angle they are identical with the mesh connection (figs. 3 and 4).

A knowledge of the quantity here designated the network angle is of considerable importance when installing three-phase transformers, as it at once determines which transformer can be paralleled on both sides without alteration. It is also important in connection with synchronised transformers. On this account the author suggests that it should be regularly stamped on the description plates. There is at present no uniformity as regards the arrangement of transformer windings, either amongst the various makers or even in transformers delivered at different times from the same factory, and in view of the large number of existing transformer installations, such uniformity cannot now be insisted on. The clear marking of transformers in this respect is, therefore, all the more necessary.

* Dr. G. Stern, *E.T.Z.*, October 10th, 1907.

Motor-Omnibuses in Berlin.—The Grand Berlin Motor-Omnibus Co., which is a subsidiary of the Grand Berlin Tramway Co. having a monopoly of electric tramways in the German capital, is on the point of making an experiment with a combined petrol-electric omnibus, which has been built in conjunction with the Siemens-Schuckert Works Co. So far, the experience gained by the omnibus company with petrol omnibuses has not been satisfactory, as the working expenses on the two lines hitherto maintained are stated to amount to nearly three times the receipts.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The year is now drawing to a close, and one may, therefore, expect the financial reports of the German manufacturing firms for 1906-7 to be published at any moment. No information is forthcoming as to the probable dividend announcements for a year of exceedingly good trade. Hopes are entertained of a large amount of railway work in the future, but the progress is exceedingly slow with the existing railways in the hands of the State, whilst schemes promoted by private enterprise, particularly in Berlin, have numerous difficulties to contend with before they emerge from the paper stage.

German Works.

The report for 1906-7 of the Kabelwerk Rheydt, of Rheydt, which was adopted at the recent general meeting, stated that the company was briskly employed during the year, and the activity still continued. The share capital was increased from £112,500 to £187,500 in the year, mainly for the purpose of establishing a copper and bronze rolling mill, which was brought into operation last May. It is added that the decline in the price of copper did not find the company unprepared. The accounts indicated net profits of £29,533, as compared with £19,950 in 1905-6, and a dividend of 15 per cent. has been declared, being the same rate as in the preceding year. The new capital has participated in the distribution for one-half of the year.

The directors of Brown, Boveri & Co., of Mannheim, in the course of their report for 1906—7, state that all departments were fully employed and that, notwithstanding the working of night shifts, it was not always possible to comply with the requirements as to delivery at the proper time. In the circumstances, orders frequently had to be declined owing to the short period stipulated for delivery. The turbine department was very satisfactorily employed, and large repeat orders were received, together with orders from new customers. The electrical branches were extraordinarily well occupied during the year, especially those for large generators and motors, high-pressure apparatus and complete high-tension installations. The accounts are briefly as undernoted:—

	1906-7.	1905-6.
Share capital	£300,000	£300,000
Obligations	225,000	—
Net profits	24,311	22,878
Dividend, per cent.	6	6

The report stated that the company had decided to erect a building for the production of insulating material so as to be independent of external sources, and that an extension had been undertaken for the construction of condensers. The number of workers employed, which amounted to 1,611 at the end of 1905-6, advanced to 1,793 at the close of the financial year.

The Deutsche Elektrizitäts Werke (Garbe, Lahmeyer & Co.), of Aix-la-Chapelle, experienced a further improvement in the year 1906-7, the gross profits on manufacturing being considerably greater than in the preceding year. The net profits amounted to £23,753, as compared with £11,911 in 1905-6, and after placing £12,500 to ordinary and special reserve funds, the balance has allowed of the payment of a dividend of 5 per cent. on a share capital of £150,000, this rate contrasting with 4 per cent. which was distributed in the previous 12 months. It was stated at the recent general meeting that the prospects of the undertaking were satisfactory.

Swiss and Austrian Works.

The Oerlikon Maschinenfabrik, after four unprofitable years, has again reached the dividend-paying stage. According to the directors' report for 1906-7, the demand was brisk, and as a consequence the level of prices constantly increased, and an abundance of work was procurable without making special efforts to secure it. In this way the severity of competition was somewhat reduced, and arrangements were made with the principal manufacturing firms in regard to common action in advancing prices. Nevertheless, the prices were not as remunerative as in the favourable years prior to 1900. The higher values under the prevailing condition of the market did not assure any materially increased business profits. The financial position may be summarised as follows:—

	1906-7.	1905-6.
Ordinary share capital	£320,000	£320,000
Obligations	160,000	160,000
Net profits	14,587	617
Dividend, per cent	4	—

The report mentions that the experimental installation of electric traction on the Seebach-Wettingen section of the Swiss Federal Railways was completed, and as the working capacity had been ascertained, there was nothing more in the way of the introduction of electrical operation on the whole of the section. In the turbine department a number of deliveries had been made, and important orders were brought over into the new financial year. The decline in activity in machine tools was more than compensated by the increased employment in the electrical branches, and the business of the foreign companies in Milan, Paris, and Madrid, was brisker than in the previous year, as also was that of the engineering offices in Stockholm and London.

The first report made public by the Machine Works of Escher, Wyss & Co., of Zurich, relates to the year 1906-7. As will be remembered, close relations were established a year or two ago with the Felten & Guilleaume-Lahmeyer Works Co., which holds about 95 per cent. of the Swiss company's share capital, which totals £200,000. It is mentioned in the report that the association with the Frankfort company had not only afforded the Zurich company greater freedom of action, but had also rendered it possible to easily carry out the necessary extensions of works, and had been the means of assuring considerable orders. All the manufacturing departments were exceptionally well employed during the year; the orders increased by 40 per cent. and the invoice values were 17 per cent. higher than in the preceding year. The net profits amounted to £17,786, and a dividend of 6 per cent. has been declared on the priority shares and 5 per cent. on the ordinary shares.

Among other Swiss companies may be mentioned the Oerlikon Accumulator Works Co., which has declared a dividend of 20 per cent. for 1906, as in the previous year; and the Zurich Wire and Cable Works Co., 15 per cent. for 1906-7, as against 10 per cent. in the preceding 12 months. On the other hand, the Compagnie de l'Industrie Electrique, of Geneva, incurred a loss of £13,900 in 1906-7, as compared with a profit of £4,000 in the previous year.

The Austrian Siemens-Schuckert Works Co., of Vienna, according to the report for 1906, received orders in that year for the equipment of 20 new electricity works, three electric tramways, extensions of 36 existing electricity works, and a large number of isolated installations. Apart from apparatus, the orders comprised 5,024 machines having a total output of 103,000 KW., as compared with 3,709 and 73,000 KW. respectively in the preceding year. The deliveries in the year amounted to 4,550 machines of 80,000 KW., as contrasted with 3,390 and 55,000 KW. in 1905. Two turbo-generators, each of 10,000 H.P., were supplied for the Vienna municipal electricity works, and a third unit of the same capacity had been ordered. The net profits reached 806,000 kr., as compared with 49,230 kr. in 1905, and a dividend of 4 per cent. has been declared, as contrasted with no distribution in the preceding year.

The directors of the Vereinigte Elektrizitäts Gesellschaft (United Electricity Co.), of Vienna, state that the company had an abundance of orders during the year 1906-7, and the turnover materially increased as compared with the preceding twelve months. According to the report, the deliveries of dynamos, motors and transformers amounted to 1,300 of a combined output of 27,900 H.P., and a large number of lighting and power installations, particularly for the mining and metallurgical and textile industries, were completed. The heavy electrical engineering department of the United Glow Lamp and Electricity Co., of Buda Pesth, was being converted into an independent company, of which the Vienna company would hold all the shares. The net profits realised by the latter in 1906-7 reached 529,773 kr., as compared with 470,089 kr. in the previous year, and a dividend of 5 per cent. has been distributed, being the same rate as in 1905-6.

The Up-to-Date Contractor.—There are several things that the contractor could do to augment his income and, incidentally, increase his happiness. Leaving aside those more obvious, and perhaps more congenial, desires of his heart—as, for example, giving the abandoned jobber a severe jolt, or chasing the fake contractor off the earth, he could undoubtedly do himself a whole lot of good by learning a little more than he now knows about the suitable placing of outlets and the relative values of the different types of electric lighting. This is a horribly neglected matter; and there is much profit and reputation for the contractor who has the sagacity to take hold of this practically unused and tremendously important branch of knowledge. They call it "illuminating engineering," but there is no need to be scared at this rather formidable name; it isn't half as discouraging as it looks. And if its very few professional votaries joyfully revel in energy curves, photometrics, luminosities and pupillary diameters, do not worry. The intelligent contractor may feel perfectly assured that a fair working knowledge of the principles governing the effective arrangement of lighting units can be easily enough acquired, and that its possession will give him an immense advantage in the game. In the onward sweep of the electric lighting art some important things have been left behind and almost forgotten. One of these neglected utilities may be described as the faculty of placing lights where they will do the most good. Perhaps as much as 90 per cent. of all lighting installations are painstakingly planned to furnish the least quantity of effective lighting for the money expended, and the result of this delightful state of affairs has been a chronic condition of dissatisfaction among users, who infallibly put the blame everywhere but in the right place. And engineers and architects have been as befuddled as everybody else. Happily a star, or a small galaxy, has risen in the east, and hereafter the illuminating engineer will have more or less to say about lighting installations.

The opportunity which is presented to the wide-awake contractor by these changing conditions is full of promise. Aside from the larger contracts, in which he is called upon only to intelligently follow the specifications, there are no end of smaller jobs in which practically everything is left to his discretion. Not only has he no specifications furnished him, but he is generally expected to specify the requirements and to advise as to the methods to be used. In fact, he assumes the burden of the whole job and bears all responsibility for the results. If his equipment includes a practical knowledge of good illuminating principles, he is able to give his customer an economical and perfectly satisfactory piece of work, and at the same time gain for himself a reputation that will bring him good business when his unprogressive neighbour is complaining of hard times.—*Electrocraft* (U.S.A.).

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

23,748. "Improvements in and connected with tramcars and the permanent ways of same." W. Crabtree and E. Palmer. October 28th.

23,756. "Electric fans." F. Diehl and A. F. Becker. (Date applied for under Patents Act, 1901, April 22nd, 1907, being date of application in United States.) October 28th. (Complete.)

23,768. "Improvements in electrically controlled compasses." Siemens Bros. & Co., Ltd., and G. S. Grimston. October 28th.

23,772. "Improvements in electrically propelled tramcars." J. Smith. October 28th.

23,774. "Improvements in or relating to electrical connection devices." O. Graetzer. October 28th. (Complete.)

23,778. "Improvements in electric resistances." C. A. Day. (Fabrik Elektrischer Zünder G.m.b.H. Germany.) October 28th. (Complete.)

23,780. "Improved reversible and collapsible trolley pole for electric vehicles." J. Lindsay and R. Lindsay. October 28th. (Complete.)

23,781. "Method of renewing the carbon rods in arc lamps having electrodes supported from below." Deutsche Beck-Bogenlampen-Ges.m.b.H. (Date applied for under Patents Act, 1901, October 26th, 1906, being date of application in Germany.) October 28th. (Complete.)

23,786. "Improvements in the manufacture of electric incandescence lamps." E. A. Gimingham. October 28th.

23,801. "Improvements in electrical water-heaters." E. J. Condon. (Date applied for under Patents Act, 1901, November 1st, 1906, being date of application in United States.) October 28th. (Complete.)

23,809. "Improvements in wire stringing devices applicable for use in the insulation of wire and for other purposes." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 28th.

23,816. "Improved means for controlling brake power on electrical tramway and railway vehicles." M. Cummins. October 29th.

23,818. "Improvements pertaining to optical lanterns and the regulation and control of light-producing agents, electric arcs, limelights, or the like, used in connection therewith, and apparatus therefor." G. Robson. October 29th.

23,854. "Duplicating all designs of glass chimneys, globes for oil, electric, or gas or any other illuminating powers." H. Jordan. October 29th.

23,857. "Improved means for attachment to the trolley boom of an electric tram, for the purpose of guiding the trolley wheel to the live overhead wire." A. S. Chapman. October 29th.

23,877. "Improvements in and relating to electro-magnetic sound producers." J. F. S. Barth and O. Lokken. October 29th. (Complete.)

23,880. "Means for generating direct current of limited strength." Felten and Guilleaume-Lahmeyerwerke Act.-Ges. (Date applied for under Patents Act, 1901, October 31st, 1907, being date of application in Germany.) October 29th. (Complete.)

23,881. "Improvements in connection with electrical installations." Felten and Guilleaume-Lahmeyerwerke Act.-Ges. (Date applied for under Patents Act, 1901, October 31st, 1906, being date of application in Germany.) October 29th. (Complete.)

23,894. "Improved electric condenser." I. Moscicki and J. de Monzelewski. (Date applied for under Patents Act, 1901, October 30th, 1906, being date of application in Switzerland) October 29th. (Complete.)

23,903. "Improvements in carbon electrodes." J. T. Szek. October 29th.

23,907. "Improvements in electrolytes for the electro-deposition of copper and other metals." H. W. Brownsdon and R. A. E. Payne. October 29th.

23,908. "Improvements in synchronised high-tension ignition systems for electrically-firing internal explosion engines and the like." J. W. Chambers and H. F. B. Bennett. October 29th.

23,914. "Improvements in electric controlling devices." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 30th.

23,915. "Improvements in and relating to electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 30th.

23,916. "Improvements in and relating to alternating current machines." M. C. A. Latour. (Date applied for under Patents Act, 1901, October 31st, 1906, being date of application in France.) October 30th. (Complete.)

23,921. "Improvements in alternating current induction motors." A. H. Kemp and P. Kemp. October 30th.

23,949. "Improved method of, and ingredients for, the manufacture of a substance suitable for electrical insulation." C. Hess. October 30th.

23,950. "Improvements in or applicable to electroliers and in ceiling roses therefor." G. F. Woods. October 30th.

23,956. "Improvements in electric signs." P. Good. October 30th.

23,957. "Improvements in or relating to electrical contact-breakers for use on internal combustion engines." S. S. Guy. October 30th.

23,977. "Improvements in or relating to electric telegraph apparatus." S. G. Brown. October 30th.

23,988. "Process for producing tungsten and the like metal combination." F. Harrison. October 30th.

23,991. "Improved joint for parts which are required to be detachably connected together, especially applicable to electric incandescent lamps and holders therefor." H. E. Theobald. October 30th.

24,002. "Improvements in or relating to electric motor controlling apparatus." E. Chaudoir. October 30th.

24,006. "Improvements in and relating to electro-magnetic relays." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) October 30th.

24,017. "Improvements in and relating to the measurement of electrical power." V. Arcioni. October 30th. (Complete.)

24,023. "Electro-medical apparatus." R. S. Cylmer and T. M. Woodhouse. (Date applied for under Patents Act, 1901, November 7th, 1906, being date of application in United States.) October 30th. (Complete.)

24,027. "Improvements in and relating to arc lamps." D. Timar and K. von Dreger. (Date applied for under Patents Act, 1901, September 7th, 1907, being date of application in Germany.) October 31th. (Complete.)

24,028. "Process for decarbonising tungsten filaments containing carbon or carbide." Wolfram-Lampen Akt.-Ges. (Date applied for under Patents Act, 1901, October 31st, 1906, being date of application in Germany.) October 30th. (Complete.)

24,074. "Improvements in and relating to the measurement of electrical power." V. Arcioni. October 31st. (Complete.)

24,079. "Improvements in insulating conduit tubes for electric lines and cables." T. Taylor. October 31st. (Complete.)

24,103. "Improvements in electrical indicators." W. E. Lake. (The Auto Pump Co., U.S.) October 31st. (Complete.)

24,135. "Improvements in alternating-current commutating electric machines." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, November 1st, 1906, being date of application in Germany.) October 31st. (Complete.)

24,138. "Improvements in electric arc lamps." A. D. Jones. November 1st.

24,153. "Improvements in the method of and means for fixing rose blocks of electric lamps to ceilings and walls." T. C. W. Tucker. November 1st.

24,154. "Improvements in or relating to magneto-electric machines." V. W. Robinson and H. W. Van Raden. November 1st.

24,165. "Electric enumerator for telephone calls." S. D. Williams. November 1st.

24,189. "Improvements in cathodes for electro-deposition of metals." A. Hill. (D. Lay, British Columbia.) November 1st.

24,197. "Improvements in and relating to apparatus for the automatic distribution of telegraphic messages." A. Lemoine. November 1st. (Complete.)

24,200. "Improvements in or relating to electric and other switches or switch operating devices." G. Gaglio and L. Villani. November 1st. (Complete.)

24,212. "Improvements in electrical indicating or recording targets." J. Y. Johnson. (Felten & Guilleaume-Lahmeyerwerke Act.-Ges., Germany.) November 1st. (Complete.)

24,231. "Improvements in and relating to systems of electric distribution." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 1st.

24,234. "Improvements in and relating to magneto and dynamo-electric generators." F. T. Reid. November 1st.

24,257. "Improvements relating to rectifiers for alternating current." S. W. Cuttriss. November 2nd.

24,260. "Improved means for operating from a distance electrical or fluid-pressure-driven organ blowing apparatus." J. Page. November 2nd. (Complete.)

24,267. "Improvements in or relating to apparatus for electrically lighting miners' safety lamps." H. M. Darrah and F. Perrins. November 2nd.

24,288. "Improvements in contact-breakers for electrical ignition in internal combustion engines." R. Bosch, trading as the firm Robert Bosch. (Date applied for under Patents Act, 1901, January 2nd, 1907, being date of application in Germany.) November 2nd. (Complete.)

24,294. "Improvements in and relating to electric bells." G. W. Mascord and T. A. E. Blake. November 2nd.

24,299. "Process for obtaining cold electric light by means of high tension electricity." D. Timar and K. von Dreger. (Date applied for under Patents Act, 1901, November 3rd, 1906, being date of application in Germany.) November 2nd. (Complete.)

24,307. "Improvements in and relating to galvanic cells having rotating electrodes." A. Steiner von Eltenberg and H. Lach. November 2nd.

23,878. "Improvements in sparking plugs." A. Holsten. October 29th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Method of and Means for Sealing Electric Conductors into or through Glass or like Vitreous Material. C. O. Bastian and G. Calvert. 19,709. September 4th.

Apparatus for Electrically Measuring the Height or the Pressure of Fluids at a Distance. D. Perrett. 20,056. September 8th. (Date applied for under International Convention, September 9th, 1905.)

Deposition of White Metallic Alloys by Electrolysis. R. B. Wheatley and F. B. Lark. 22,002. October 5th.

Space Telegraphy. S. Cabot. 22,107. October 6th. (Date applied for under International Convention, November 18th, 1905.)

Controllers for Electric Currents of High Tension. F. Krizik. 22,218. October 8th.

Electric Arc Lamps. Johnson & Phillips, Ltd., and C. Tubbs. 22,489. October 11th.

Electric Switch Operating Apparatus. I. L. van Buskirk. 23,389. October 22nd.

Luminous Advertisement Devices. J. Levy. 24,198. October 30th.

Purification of Tantalum. British Thomson-Houston Co. (General Electric Co., United States.) 24,234. October 30th.

Use of Radio-Active Substances for Medical and Surgical Purposes. M. Monroe and Kingsway Syndicate. 21,693. November 3rd.

Electrolytic Deposition of Metals. S. O. Cowper-Coles. 24,985. November 6th.

Electro-Mechanical Transmission Devices. M. Johannet. 25,988. November 16th. (Date applied for under International Convention, December 4th, 1905.)

Methods and Means for Insulating the Supports of Electric Conductors. C. E. Egner. 26,290. November 20th.

Lamps for Magnetic Compasses. H. H. Lake. (W. E. Hadlock and A. C. Glover.) 26,523. November 23rd.

Electrical Connection Devices. W. W. Strode and G. H. White. 26,926. November 27th.

Protective Devices for Electric Installations. Allgemeine Elektricitäts Ges. 26,989. November 27th. (Date applied for under International Convention, November 28th, 1905.)

Brush Rocking Gear for Dynamo-Electric Machines. H. Leitner. 26,995. November 27th.

Automatic Block Signalling Systems for Railways. J. Sayers. 28,273. December 12th.

Trolley Wire Clip for Overhead Electric Tramways and the like. F. E. Imeson, A. H. Finch and F. Imeson. 28,321. December 12th.

Arc Lamps. E. J. C. Crétaux. 29,657. December 29th. (Date applied for under International Convention, December 30th, 1905.)

1907.

Electrical Fuse. A. G. Charters and J. G. Jones. 11,952. May 23rd.

Ventilating Dynamo-Electric Generators, Motors and the like. Siemens Schuckertwerke Ges. 12,053. May 24th. (Date applied for under International Convention, May 31st, 1906.)

Secondary Batteries. R. Ziegenberg. 14,756. June 26th. (Date applied for under International Convention, August 10th, 1906.)

Secondary Batteries. R. Ziegenberg. 14,762. June 26th. (Date applied for under International Convention, August 11th, 1906.)

Electricity Meters for Use with Alternating Currents. H. J. Haddan. (Bergmann Elektricitätswerke Akt.-Ges.) 15,551. July 5th.

Alternating-Current Electric Motors of the Commutator Type. Allgemeine Elektricitäts Ges. 16,629. July 18th. (Date applied for under International Convention, July 19th, 1906.)

Holders for Electric Incandescent Lamps. G. Davis. 18,227. August 12th.

Apparatus for Illustrating Mechanically the Laws Governing the Oscillation and Deflection of Magnetic Needles, and for Certain Mechanical Experiments. W. Bennett. 817. January 12th.

Receivers for Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 867. January 12th.